UNITED STATES AIR FORCE

SUMMER RESEARCH PROGRAM -- 1993

SUMMER RESEARCH PROGRAM FINAL REPORTS

VOLUME 1

PROGRAM MANAGEMENT REPORT

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The United States Air Force Summer Research Program (USAF-SRP) is designed to introduce university, college, and technical institute faculty members, graduate students, and high school students to Air Force research. This is accomplished by the faculty members, graduate students, and high school students being selected on a nationally advertised competitive basis during the summer intersession period to perform research at Air Force Research Laboratory (AFRL) Technical Directorates and Air Force Air Logistics Centers (ALC). The management volume consists of a program overview, program management statistics, a listing of the participants, and an abstract for each participants summer research.

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1. INTRODUCTION

The Summer Research Program (SRP), sponsored by the Air Force Office of Scientific Research (AFOSR), offers paid opportunities for university faculty and graduate students, and for high school students, to conduct research in U.S. Air Force research laboratories nationwide during the summer.

Introduced by AFOSR in 1978, this innovative program is based on the concept of teaming academic researchers with Air Force scientists in the same disciplines using laboratory facilities and equipment not often available at associates' institutions.

AFOSR also offers its research associates an opportunity, under its Summer Research Extension Program (SREP), to continue their AFOSR-sponsored research at their home institutions through the award of research grants. For SREP research in calendar year 1994, the maximum amount of each grant increased from $20,000 to $25,000, and the number of AFOSR-sponsored grants decreased from 75 to 60. A separate annual report is compiled on the SREP.

The Summer Faculty Research Program (SFRP) is open annually to approximately 150 faculty members with at least two years of teaching and/or research experience in accredited U.S. colleges, universities, or technical institutions; and SFRP associates must be either U.S. citizens or permanent residents.

The Graduate Student Research Program (GSRP) is open annually to approximately 100 graduate students holding a bachelor's or a master's degree; GSRP associates must be U.S. citizens enrolled full time at an accredited institution.

The High School Apprentice Program (HSAP) annually selects about 125 high school students located within commuting distance of participating Air Force laboratories.

The numbers of projected summer research participants in each of the three categories are usually increased through direct sponsorship of participating laboratories.

AFOSR's SRP has well served its objectives of building critical links between Air Force research laboratories and the academic community; opening avenues of communications and forging new research relationships between Air Force and academic technical experts in areas of national interest; and strengthening the nation's efforts to sustain careers in science and engineering. The success of the SRP can be gauged from its growth from its inception (shown in Table 1) and from the favorable responses the 1993 participants expressed in end-of-tour SRP evaluations (Appendix B).

AFOSR contracts for administration of the SRP by civilian contractors. The contract was awarded to Research & Development Laboratories (RDL) in September 1990. The 1993 SRP was RDL's last year under the current contract.

2. PARTICIPATION IN THE SUMMER RESEARCH PROGRAM

The SRP began with faculty associates in 1979; graduate students were added in 1982 and high school students in 1986. The following table shows the number of associates in the program each year.

Table 1: SRP Participation, by Year

YEAR	Number of Participants			TOTAL
	SFRP	GSRP	HSAP	
1979	70			70
1980	87			87
1981	87			87
1982	91	17		108
1983	101	53		154
1984	152	84		236
1985	154	92		246
1986	158	100	42	300
1987	159	101	73	333
1988	153	107	101	361
1989	168	102	103	373
1990	165	121	132	418
1991	170	142	132	444
1992	185	121	159	464
1993	187	117	136	440

Again this year, laboratories funded fewer GSRP associates than last year, perhaps reflecting budget cuts. The lower number of HSAP associates is largely a result of the Office of the Secretary of Defense electing not to fund some 20 Armstrong Laboratory Environmental Studies slots they had provided in 1992.

3. RECRUITING AND SELECTION

The SRP is conducted on a nationally advertised and competitive-selection basis. The advertising for faculty and graduate students consisted primarily of the mailing of 12,000 40-page SRP brochures to chairpersons of departments relevant to AFOSR research and to administrators of grants in accredited universities, colleges, and technical institutions. Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) were included. Brochures also went to all participating USAF laboratories, the previous year's participants, and numerous individual requestors.

The 1993 SRP opportunity was also advertised in four journals: *Black Issues in Higher Education, Chemical & Engineering News, IEEE Spectrum* and *Physics Today*.

High school applicants can participate only in laboratories located no more than 20 miles from their residence. Tailored brochures on the HSAP were sent to the head counselors of 180 high schools in the vicinity of participating laboratories, with instructions for publicizing the program in their schools. High school students selected to serve at Wright Laboratory's Armament Directorate (Eglin Air Force Base, Florida) serve eleven weeks as opposed to the eight weeks normally worked by high school students at all other participating laboratories.

Each SFRP or GSRP applicant is given a first, second, and third choice of laboratory. High school students who have more than one laboratory or directorate near their homes are also given first, second, and third choices.

Laboratories make their selections and prioritized their nominees. AFOSR then determines the number to be funded at each laboratory and approves laboratories' selections.

Subsequently, laboratories use their own funds to sponsor additional candidates. Some selectees do not accept the appointment, so alternate candidates are chosen. This multi-step selection procedure results in some candidates being notified of their acceptance after scheduled deadlines. The total applicants and participants for 1993 are shown in this table.

Table 2: 1993 Applicants and Participants

PARTICIPANT CATEGORY	TOTAL APPLICANTS	SELECTEES	DECLINING SELECTEES
SFRP (HBCU/MI)	653	187 (13)	25 (3)
GSRP (HBCU/MI)	275	117 (2)	19 (1)
HSAP	475	136	7
TOTAL	1403	440	51

4. SITE VISITS

During June and July of 1993, representatives of RDL visited each participating laboratory to provide briefings, answer questions, and resolve problems for both laboratory personnel and participants. The objective was to ensure that the SRP would be as constructive as possible for all participants. Both SRP participants and RDL representatives found these visits beneficial. For many of the laboratories, this was the only opportunity for all participants to meet at one time to share their experiences and exchange ideas.

5. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES AND MINORITY INSTITUTIONS (HBCU/MIs)

In previous years, an RDL program representative visited from seven to ten different HBCU/MIs to promote interest in the SRP among the faculty and graduate students. This year, the RDL Program Manager attended an HBCU/MI consortium with representatives from 48 HBCU/MIs, which was held at Clark Atlanta University in Atlanta, Georgia.

In addition to RDL's special recruiting efforts, AFOSR attempts each year to obtain additional funding or use leftover funding from cancellations the past year to fund HBCU/MI associates. This year, four HBCU/MI SFRPs and two HBCU/MI GSRPs declined after they were selected.The following table records HBCU/MI participation in this program.

Table 3: SRP HBCU/MI Participation, by Year

YEAR	SFRP		GSRP	
	Applicants	Participants	Applicants	Participants
1985	76	23	15	11
1986	70	18	20	10
1987	82	32	32	10
1988	53	17	23	14
1989	39	15	13	4
1990	43	14	17	3
1991	42	13	8	5
1992	70	13	9	5
1993	60	13	6	2

6. SRP FUNDING SOURCES

Funding sources for the 1993 SRP were: the AFOSR-provided slots for the basic contract; laboratory funds; and AFOSR funds remaining from the previous year. Funding sources by category for the 1993 SRP selected participants are shown here.

Table 4: 1993 SRP Associate Funding

FUNDING CATEGORY	SFRP	GSRP	HSAP
AFOSR BASIC ALLOCATION FUNDS	150	98*	125
USAF LABORATORY FUNDS	27	19	11
SLOTS ADDED BY AFOSR (USING LEFTOVER FUNDS)	2	--	--
HBCU/MI BY AFOSR (USING LEFTOVER FUNDS)	8	--	--
TOTAL	187	117	136

* 100 were selected, but two cancelled too late to be replaced.

7. COMPENSATION FOR PARTICIPANTS

Compensation for SRP participants, per five-day work week, is shown in this table.

Table 5: 1993 SRP Associate Compensation

PARTICIPANT CATEGORY	1991	1992	1993
Faculty Members	$690	$718	$740
Graduate Student (Master's Degree)	$425	$442	$455
Graduate Student (Bachelor's Degree)	$365	$380	$391
High School Student (First Year)	$200	$200	$200
High School Student (Subsequent Years)	$240	$240	$240

The program also offered an expense allowance (seven days per week) of $50/day for faculty and $37/day for graduate students whose homes were more than 50 miles from the laboratory.

Transportation to the laboratory at the beginning of their tour and back to their home destinations at the end was also reimbursed for these participants. Of the combined SFRP and GSRP associates, 67% (209 out of 304) claimed travel reimbursements at an average round-trip cost of $696.

Faculty members were encouraged to visit their laboratories before their summer tour began. All costs of these orientation visits were reimbursed. Fifty-eight percent (109 out of 187) of faculty associates took orientation trips at an average cost of $685.

Program participants submitted biweekly vouchers countersigned by their laboratory research focal point, and RDL issued paychecks so as to arrive in associates' hands two weeks later.

HSAP program participants were considered actual RDL employees, and their respective state and federal income tax and Social Security were withheld from their paychecks. By the nature of their independent research, SFRP and GSRP program participants were considered to be consultants or independent contractors. As such, SFRP and GSRP associates were responsible for their own income taxes, Social Security, and insurance.

8. CONTENTS OF THE 1993 REPORT

The complete set of reports for the 1993 SRP includes this program management report augmented by fifteen volumes of final research reports by the 1993 associates as indicated below:

Table 6: 1993 SRP Final Report Volume Assignments

	VOLUME		
LABORATORY	SFRP	GSRP	HSAP
Armstrong	2	7	12
Phillips	3	8	13
Rome	4	9	14
Wright	5A, 5B	10	15
AEDC, FJSRL, WHMC	6	11	16

AEDC = Arnold Engineering Development Center
FJSRL = Frank J. Seiler Research Laboratory
WHMC = Wilford Hall Medical Center

APPENDIX A -- PROGRAM STATISTICAL SUMMARY

A. Colleges/Universities Represented

Selected SFRP and GSRP associates represent 169 different colleges, universities, and institutions.

B. States Represented

SFRP - Applicants came from 48 states plus Washington D.C., Israel, Puerto Rico, and the United Kingdom. Selectees represent 38 states plus Washington D.C., Puerto Rico, and the United Kingdom. (The United Kingdom selectee was a U.S. citizen on sabbatical.)

GSRP - Applicants came from 39 states and Puerto Rico. Selectees represent 31 states and Puerto Rico.

HSAP - Applicants came from sixteen states. Selectees represent ten states.

C. Academic Disciplines Represented

The academic disciplines of the combined 304 SFRP and GSRP associates are as follows:

Electrical Engineering	24%
Mechanical Engineering	14%
Physics	13%
Aerospace	8%
Chemistry	7%
Math	5%
Psychology	5%
Other Engineering Fields	5%
Biology	4%
Computer Science	4%
Industrial/Engineering Technology	3%
TOTAL	92%

The remaining 8% consists of Communications, Sociology, Marine Biology, Pharmaceuticals, Physiology, Zoology, Polymer Science, Sports Science, and Metallurgy.

Table A-1. Total Participants

Number of Participants	
SFRP	187
GSRP	117
HSAP	136
TOTAL	440

Table A-2. Degrees Represented

Degrees Represented			
	SFRP	GSRP	TOTAL
Doctoral	175	0	175
Master's	12	46	58
Bachelor's	0	71	71
TOTAL	187	117	

Table A-3. SFRP Academic Titles

Academic Titles	
Assistant Professor	79
Associate Professor	54
Professor	37
Instructor	3
Chairman	2
Visiting Professor	1
Visiting Assoc. Prof.	1
Research Associate	10
TOTAL	187

Table A-4. Source of Learning About SRP

SOURCE	SFRP		GSRP	
	Applicants	Selectees	Applicants	Selectees
Applied/participated in prior years	34%	45%	17%	25%
Colleague familiar with SRP	18%	20%	25%	20%
Brochure mailed to institution	23%	12%	12%	2.5%
Contact with Air Force laboratory	10%	19%	14%	25%
Journal ad: *IEEE Spectrum*	7%	0.8%	4%	2.5%
Chemical & Engineering News	2%	--	--	--
Physics Today	3%	--	2.5%	0.8%
Black Issues in Higher Education	0.5%	0.8%	0.4%	0.8%
Other source	2.6%	2.5%	23%	24%
TOTAL	100%	100%	100%	100%

NOTE: Of the GSRPs who selected "other source," most listed their faculty adviser as the source of learning about the SRP.

Table A-5. Ethnic Background of Applicants and Selectees

	SFRP		GSRP		HSAP	
	Applicants	Selectees	Applicants	Selectees	Applicants	Selectees
American Indian or Native Alaskan	0.8%	--	0.7%	--	0.6%	0.7%
Asian/Pacific Islander	34%	28%	7%	6%	3%	3%
Afro-American	3%	2%	5%	2%	4%	0.7%
Hispanic	3%	1%	6%	4%	18%	13%
Caucasian	53%	62%	75%	85%	68%	66%
Preferred not to answer	6%	7%	7%	2%	7%	16%
TOTAL	100%	100%	100%	100%	100%	100%

Table A-6. Percentages of Selectees receiving their 1st, 2nd, or 3rd Choices

	1st Choice	2nd Choice	3rd Choice
SFRP	67%	16%	9%
GSRP	71%	14%	6%

APPENDIX B -- SRP EVALUATION RESPONSES

1. OVERVIEW

Evaluations were completed and returned to RDL by four groups at the completion of the SRP. The number of respondents in each group is shown below.

Table B-1. Total SRP Evaluations Received

Evaluation Group	Responses
SFRP & GSRPs	265
HSAPs	118
USAF Laboratory Focal Points	158
USAF Laboratory HSAP Mentors	68

All groups indicate near-unanimous enthusiasm for the SRP experience.

Typical comments from 1993 SRP associates are:

> "[The SRP was an] excellent opportunity to work in state-of-the-art facility with top-notch people."

> "[The SRP experience] enabled exposure to interesting scientific application problems; enhancement of knowledge and insight into 'real-world' problems."

> "[The SRP] was a great opportunity for resourceful and independent faculty [members] from small (poor) colleges to obtain research credentials."

> "The laboratory personnel I worked with are tremendous, both personally and scientifically. I cannot emphasize how wonderful they are."

> "The one-on-one relationship with my mentor and the hands on research experience improved [my] understanding of physics in addition to improving my library research skills. Very valuable for [both] college and career!"

Typical comments from laboratory focal points and mentors are:

> "It has helped my staff tremendously in terms of scientific productivity i.e., journal articles. And it gives the university professors a better understanding of what are important areas of research to [Air Force laboratories]. Both the Air Force and the university are winners!"

> "With bright and enthusiastic faculty/graduate students as I worked with this summer, the [SRP] more than justifies itself. I would really like to have them back next summer."

> "A well-run, worthwhile program."

The summarized recommendations for program improvement from both associates and laboratory personnel are listed below.

A. Better preparation prior to associates' arrival i.e., office space, computer assets, clearly defined scope of work.

B. Each laboratory sponsoring seminar presentations of work conducted by associates, and/or organized social functions for associates to collectively meet and share SRP experiences.

C. The Air Force laboratory focal points collectively suggest more AFOSR allocated associate positions, so that more people may share in the experience.

D. The associates collectively suggest higher stipends for SRP associates.

E. Both HSAP Air Force laboratory mentors and associates would like the summer tour extended from the current 8 weeks to either 10 or 11 weeks.

Two recommendations from previous years for program improvement which were implemented this year were the use of electronic-mail (e-mail) as a means of communicating with RDL and a housing database. Since May of 1993 when RDL first supported e-mail, over 120 associates chose to use the convenience of e-mail. A housing database was compiled from previous year's faculty and graduate associates on where they stayed and their associated costs during their SRP tour. This database was broken down by Air Force Base, and although it wasn't completed in time for distribution to the faculty associates, it was distributed to the graduate students. During the June and July laboratory visits, RDL representatives received positive feedback from associates on both of these improvements.

2. 1993 USAF LABORATORY FOCAL POINT (LFP) EVALUATION RESPONSES

The summarized results listed below are from the 158 LFP evaluations received.

1. LFP associate preferences:

Table B-2. Air Force LFP Preferences For Associates By Type, Given In Percentages

Number of Associates	SFRP		GSRP Accompanying SFRP		GSRP Unaccompanied	
	# in 1993	Preferred	# in 1993	Preferred	# in 1993	Preferred
0	20%	18%	77%	55%	69%	63%
1	71%	58%	20%	34%	23%	24%
2	7%	20%	0.6%	7%	8%	11%
3+	2%	4%	3%	4%	--	2%
Total	99%	100%	100%	100%	100%	100%

LFPs were asked to rate the following questions on a scale from
1 (below average) to 5 (above average)

2. LFPs involved in SRP associate application evaluation process: 83%

   a. Time available for evaluation of applications: 3.0
   b. Adequacy of applications for selection process: 3.2

3. Value of orientation trips: 4.0

4. Length of research tour: 3.7

5 a. Benefits of associate's work to laboratory: 4.4
  b. Benefits of associate's work to Air Force: 4.1

6.	a. Enhancement of research qualifications for LFP and staff:	3.9
	b. Enhancement of research qualifications for SFRP associate:	4.1
	c. Enhancement of research qualifications for GSRP associate:	4.2
7.	a. Enhancement of knowledge for LFP and staff:	4.0
	b. Enhancement of knowledge for SFRP associate:	4.2
	c. Enhancement of knowledge for GSRP associate:	4.2
8.	Value of Air Force and university links:	4.6
9.	Potential for future collaboration:	4.5
10.	a. Your working relationship with SFRP:	4.6
	b. Your working relationship with GSRP:	4.5
11.	Expenditure of your time worthwhile:	4.4
12.	Quality of program literature for associate:	4.0
13.	a. Quality of RDL's communications with you:	3.6
	b. Quality of RDL's communications with associates:	3.6
14.	Overall assessment of SRP:	4.4
15.	Number of LFPs whose associates experienced problems in:	
	a. Lab equipment/supplies late:	14
	b. Inadequate lab space/resources:	9
	c. Conflicts in computer usage:	9
	d. Finding housing:	6
	e. Cash flow/payment problems:	7
	f. Laboratory administrative problems:	3
	g. Delays in security clearance:	3
	h. Insufficient time for meaningful work:	11
	i. Other problems:	9

3. 1993 SFRP & GSRP EVALUATION RESPONSES

The summarized results listed below are from the 265 SFRP/GSRP evaluations received.

Associates were asked to rate the following questions on a scale from 1 (below average) to 5 (above average)

1. The match between the laboratories research and your field:		4.6
2. Your working relationship with your LFP:		4.7
3. Enhancement of your academic qualifications:		4.3
4. Enhancement of your research qualifications:		4.4
5. Lab readiness for you: LFP, task, plan:		4.4
6. Lab readiness for you: equipment, supplies, facilities:		4.1
7. Lab resources:		4.2
8. Lab research and administrative support:		4.5
9. Adequacy of brochure and associate handbook:		4.2
10. RDL communications with you:		4.3
11. Overall payment procedures:		4.1
12. Overall assessment of the SRP:		4.5
13. a. Would you apply again?	Yes:	91%
b. Will you continue this or related research?	Yes:	98%
14. Was length of your tour satisfactory?	Yes:	91%
15. Percentage of associates who engaged in:		
a. Travel, while at laboratory:		31%
b. Seminar presentation:		50%
c. Technical meetings:		57%
d. Informal discussions:		77%
e. Social functions:		46%

4. 1993 USAF LABORATORY HSAP MENTOR EVALUATION RESPONSES

The summarized results listed below are from the 68 mentor evaluations received.

1. Mentor apprentice preferences:

Table B-3. Air Force Mentor Preferences for Apprentices, Given In Percentages

Number of Apprentices	# in 1993	Preferred
0	6%	19%
1	82%	64%
2	9%	15%
3+	3%	1%
Total	100%	100%

Mentors were asked to rate the following questions on a scale from 1 (below average) to 5 (above average)

2. Mentors involved in SRP apprentice application evaluation process: 70%

    a. Time available for evaluation of applications: 2.6
    b. Adequacy of applications for selection process: 2.8

3. Laboratory's preparation for apprentice: 3.4

4. Mentor's preparation for apprentice: 3.6

5. Length of research tour: 3.4

6. Benefits of apprentice's work to U.S. Air force: 3.9

7. Enhancement of academic qualifications for apprentice: 4.4

8. Enhancement of research skills for apprentice: 4.2

9. Value of U.S. Air Force/high school links:	4.0
10. Mentor's working relationship with apprentice:	4.2
11. Expenditure of mentor's time worthwhile:	4.0
12. Quality of program literature for apprentice:	3.6
13. a. Quality of RDL's communications with mentors:	3.2
b. Quality of RDL's communication with apprentices:	3.4
14. Overall assessment of SRP:	4.0

5. 1993 HSAP EVALUATION RESPONSES

The summarized results listed below are from the 118 HSAP evaluations received.

HSAP apprentices were asked to rate the following questions on a scale from 1 (below average) to 5 (above average)

1.	Apprentices influence on research topic/type of work:	3.5
2.	Apprentices working relationship with their mentor and other lab scientists:	4.7
3.	Laboratory's readiness for apprentice: mentor, task, work plan:	3.8
4.	Laboratory's readiness for apprentice: supplies, equipment, facilities:	4.2
5.	Technically challenging work:	4.0
6.	Participation in SRP has increased interest in science/math:	4.1
7.	Enhancement of apprentice's academic qualifications:	4.4
8.	Enhancement of apprentice's research qualifications:	4.3
9.	SRP influence on apprentice's career:	3.7
10.	Performance of hands-on research:	4.0
11.	Apprentice's contribution to USAF/national interests:	3.5
12.	Opportunities to meet with other HSAP apprentices:	3.7
13.	Adequacy of RDL's advertising/recruiting brochure:	3.0
14.	Adequacy of RDL's procedural brochure and administrative materials:	3.6
15.	Responsiveness of RDL's communications:	3.7
16.	Overall payment procedures:	3.7
17.	Amount of pay:	3.7
18.	Overall assessment of HSAP value to apprentices:	4.4

19. Would you apply again next year? Yes: 99%

20. Was length of SRP tour satisfactory? Yes: 82%

21. Percentages of apprentices who engaged in:

a. Seminar presentation:	43%
b. Technical meetings:	60%
c. Informal discussions:	74%
d. Social functions:	67%

SFRP Participant Data

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Laboratory: RL/ER
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Bautista, Jennifer

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HSAP Participant Data

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Cook, Theresa

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Laboratory: WL/MN
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Laboratory: AL/CF
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Deibler, Nancy

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Laboratory: AEDC/
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Laboratory: WL/FI
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Finch, David 501 Niagara Ave. Colonel White High School Dayton, OH 45405-0000	Laboratory: AL/OE Vol-Page No: 12-33
Focht, Jeremy 2660 Dayton-Xenia Rd. Beavercreek High School Beavercreek, OH 45434-0000	Laboratory: WL/ML Vol-Page No: 15-22
Foley, Jennifer 2660 Dayton-Xenia Rd. Beavercreek High School Beavercreek, OH 45434-0000	Laboratory: WL/EL Vol-Page No: 15- 9
Foth, Angela 501 Mosley Dr. A. Crawford Mosley High School Lynn Haven, FL 32444-0000	Laboratory: AL/EQ Vol-Page No: 12-21
Fowler, Brendon Chenango Ave. Clinton Senior High School Clinton, NY 13323-0000	Laboratory: RL/C3 Vol-Page No: 14- 2
Garcia, Stephanie 650 Ingram Oliver Wendell Holmes San Antonio, TX 78238-0000	Laboratory: AL/AO Vol-Page No: 12- 6
Garcia, Alejandro 2515 Navajo St. South San Antonio High School San Antonio, TX 78224-0000	Laboratory: AL/CF Vol-Page No: 12-11
Garcia, Andrea 6701 Fortuna Rd. NW West Mesa High School Albuquerque, NM 87121-0000	Laboratory: PL/SX Vol-Page No: 13-14
Gavornik, Jeffrey 5110 Walzem Rd. Roosevelt High School San Antonio, TX 78239-0000	Laboratory: AL/CF Vol-Page No: 12-12
Giles, Mark 1204 Harrison Ave. Bay High School Panama City, FL 32401-0000	Laboratory: AL/EQ Vol-Page No: 12-22

HSAP Participant Data

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Gonzalez, Christopher
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Vol-Page No: 12-34

Gooden, Christie

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Laboratory: WL/MN
Vol-Page No: 15-30

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Laboratory: RL/ER
Vol-Page No: 14- 9

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Vol-Page No: 14- 1

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Harrison, Deanna

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Laboratory: WL/MN
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Hayduk, Eric
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Hemmer, Laura

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Laboratory: WL/MN
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HSAP Participant Data

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Hodges, Melanie
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Laboratory: WL/PO
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Jeffcoat, Mark

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Laboratory: WL/MN
Vol-Page No: 15-33

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Vol-Page No: 13- 2

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Vol-Page No: 13-10

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Vol-Page No: 15-24

Kress, Barry

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Laboratory: WL/MN
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Kulesa, Joel
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Lormand, Bradley
PO Drawer CC
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Laboratory: PL/RK
Vol-Page No: 13-11

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HSAP Participant Data

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Vol-Page No: 16- 4

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McEuen, Eric
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Albuquerque, NM 87102-0000

Laboratory: PL/VT
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McGovern, Scott
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Bellbrook, OH 45305-0000

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Vol-Page No: 15- 3

McPherson, Sandra
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Laboratory: WL/ML
Vol-Page No: 15-25

Menge, Sean
Route 294
Adirondack High School
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Laboratory: RL/C3
Vol-Page No: 14- 3

Merrill, Benjamin
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Bellbrook, OH 45305-0000

Laboratory: WL/FI
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Middleton, Charles
4524 Linden Ave.
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Dayton, OH 45432-0000

Laboratory: WL/FI
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Miksch, Virginia
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San Antonio, TX 78284-0000

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Vol-Page No: 12-13

Moore II, Elliot
Laboratory: WL/MN
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Mortis, Rebecca
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San Antonio, TX 78284-0000
Laboratory: AL/HR
Vol-Page No: 12-28

Morton, Gilbert
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Manchester, TN 37355-0000
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Vol-Page No: 16- 5

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San Antonio, TX 78215-0000
Laboratory: AL/OE
Vol-Page No: 12-35

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Laboratory: AL/CF
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Olson, Amanda
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7173 FM 1628
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Panara, Michael
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Laboratory: RL/C3
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Penn, Alexander

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Laboratory: WL/MN
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Perry, Kyle

Crestview High School
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Laboratory: WL/MN
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Pletcher, Mary

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Laboratory: WL/MN
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Vol-Page No: 14- 6

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Laboratory: WL/PO
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Laboratory: AL/EQ
Vol-Page No: 12-24

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HSAP Participant Data

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Laboratory: PL/RK
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Lynchburg, TN 37352-0000
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Rodriguez, Luis
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Wayne High School
Huber Heights, OH 45424-0000
Laboratory: AL/CF
Vol-Page No: 12-15

Rosenbaum, David
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Laboratory: WL/MN
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Salinas, Carol
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Incarnate Word High School
San Antonio, TX 78212-0000
Laboratory: AL/CF
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Schanding, Sarah
7173 FM 1628
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Vol-Page No: 12-17

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Vol-Page No: 14-14

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Los Lunas High School
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Vol-Page No: 13- 8

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HSAP Participant Data

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Vol-Page No: 12- 7

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Laboratory: WL/MN
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MODEL-BASED SOFTWARE SYNTHESIS FOR LARGE SYSTEMS

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Abstract

This paper describes techniques for knowledge representation and compilation of large software systems in a model-based, automatic program synthesis environment. Domain specific declarative models are used to represent specifications and implementation strategies for reactive systems. Dynamic re-synthesis of an executing system is supported, allowing the system structure to adapt to the external or internal environment. The paper describes an application of these techniques to a large, high performance parallel instrumentation system used for analysis of turbine engine strain gauge signals produced during altitude testing. The unique features of this approach include: explicit domain-specific declarative models; graphical representation of models; multiple aspect models; automatic specification of the necessary hardware architecture; and on-line re-synthesis of dynamic systems.

WAVE PROPAGATION DURING HIGH VELOCITY IMPACT ON COMPOSITE MATERIALS

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Abstract

Understanding the response of laminated composite materials to ballistic impacts is of interest to those responsible for designing and maintaining airplanes that must be able to withstand some level of damage. As a first step towards understanding the process of damage development under high velocity impacts, an extensive series of tests was conducted in order to measure transverse normal stresses, at several locations through the thickness of the laminate, during high velocity impact. Significant damage is expected to be introduced from the initial passage of the impact generated stress wave and the tensile reflected wave. High compressive stresses induce shattering or shear failure near the impacted face while tensile stresses induce delaminations near the back face. These two zones are thought to be defined in the early stages of the impact.

The objective of the present invistigation is to develop a mathematical model capable of analyzing wave propagation through the thickness of the laminate during the early stages of the impact event in order to fully explain what is recorded during the experiments. A one dimensional analysis is developed accounting for nonlinear material behavior, the presence of adhesive layers where stress gages are located, and viscoelastic effects. A finite element model is developed and the governing equations are solved used Newmark's step by step integration. Results are presented showing that the numerical model is able to reproduce most of the significant features of the measured signals.

TRANSPORT DELAY MEASUREMENT IN FLIGHT SIMULATORS

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Department of Electrical Engineering Technology
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Abstract

Transport delay measurement has been studied over the past few years in both methods the time domain and the frequency domain techniques. This report explain the phase-lock loop method to measure the delay. The phase lock acquires lock after certain time, this time is correlated to the transport delay time. Also the loop error decays to zero as the loop track the incoming signal as soon as the phase lock loop(pLL)is in complete lock. This report will discuss the delay in general and how the phase-lock loop will be able to track the incoming signal and measure the delay.

DETERMINATION OF THE REDOX CAPACITY OF SOIL SEDIMENT BY SPECTROELECTROCHEMICAL COULOMETRIC TITRATION

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Professor
and
Tashia V. Sullins
Graduate Student
Department of Chemistry
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Abstract

The oxidative redox capacity was determined for size-fractionated soil sediment samples by the method of spectroelectrochemical coulometric titration. This method involves the measurement of absorbance of sediment particle slurries at the wavelength absorption maxima of the optically detectable mediator-titrant (reporter) molecules resorufin and methyl viologen as a function of the charge passed in a constant-potential coulometric titration. Titrations were carried out on diluted samples of gravitationally sedimented particle fractions containing particles smaller than 2 micrometers average diameter. The fraction containing particles of size < 2 micrometers was 0.115 % by weight of the initial sample slurry, which was 4.3 % solids by weight. The total organic content of the < 2 micromenter solids was 3.5 % organic carbon by weight. Titration was carried out at a diluted sediment particle concentration of 0.0128 % by weight. Resorufin was reduced first, followed by an irreversibly reducible sediment component which was consistently observed to titrate between resorufin and methyl viologen, and finally methyl viologen. The reducible component, which was absent from titration blanks, was not reoxidized when the methyl viologen and resorufin were electrochemically reoxidized. The sediment fraction studied had an oxidative redox capacity of 15 $\pm$ 2.5 millicoulombs, corresponding to 0.65 milliequivalents per gram of sediment. The heterogeneity of the original sample was evidenced by the observation that the whole sediment slurry became reducing, whereas the fractionated < 2 micrometer particle slurry remained oxidizing.

THE EFFECTS OF ANISOPLANATISM ON SHEAR COHERENT INTERFEROMETRIC PHOTOGRPHY

Richard Anderson
Professor Emeritus
Department of Physics
University of Missouri-Rolla

Astract

In order to image a spaced based object with a telescope and recording the heterodyne Fourier image on a detector array it is necessary that the atmospheric phase distortion is removed in the three mixed heterodyne signals corresponding to the three angularly displaced beams. Two beams make small angles θ_x and θ_y to a centered beam. The Fourier images are produced by parallel bundles of scattered waves. The phase mutual coherence function is calculated for parallel bundles and the accuracy of the calculation depends on knowing C_N^2 versus altitude for the specilic atmospheric conditions at the time of the measurement.

MODELING OF FLEXIBLE BODIES FOR THE ATB MODEL

Hashem Ashrafiuon
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Department of Mechanical Engineering
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Abstract

The Articulated Total Body (ATB) is a rigid body dynamic model of the human body used at the Armstrong Aerospace Medical Research Laboratory (AAMRL). The model is used to determine the mechanical response of the human body in different dynamic environments such as aircraft pilot ejection, sled test, etc. In order to predict the response accurately, however, a rigid body dynamic model may not be sufficient. This is particularly true for the relatively "soft" segments such as the neck and in high speed applications. In this study, a flexible body model of the ATB is presented which incorporates small linear deformations of individual segments in the model. The finite element method is used to develop linearly elastic models of the flexible bodies. Mode shapes and structural stiffness and damping characteristics are determined using modal analysis. The information generated by the finite element models is then fed into the revised version of the ATB model. This report presents the analytical formulation of the coupling between the gross motion of the human body and small deformation of individual flexible segments.

MULTIMODAL MEASURES OF MENTAL WORKLOAD DURING COMPLEX TASK PERFORMANCE

Richard W. Backs
Assistant Professor
Department of Psychology

and

Arthur M. Ryan
Graduate Student
Department of Psychology

Wright State University

Abstract

Central and autonomic nervous system measures of mental workload were examine concurrently during tasks that varied in their perceptual/central and physical demands. A cognitive arithmetic and continuous manual tracking task were performed singly and together. The perceptual/central demand of the cognitive arithmetic task was manipulated by varying the number of addition and subtraction operations required to solve a problem. The physical demand of a single-axis, second-order compensatory tracking task was manipulated by varying the amount of force operators had to apply to the joystick. Multiple psychophysiological responses were recorded during task performance including: electroencephalographic, cardiovascular, pulmonary, and eye blink measures. Data will be collected from twenty-four subjects, but only preliminary analyses on a subset of responses from selected subjects are available at this time.

A High Voltage One-Shot Switch Implemented With a FET Current Source and Avalanche Diode

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ABSTRACT

The description of a novel circuit which utilizes a FET current source and high voltage diode to realize a simple, inexpensive, one shot high voltage switch is presented. The switch was specifically designed for slapper detonators or other applications where speed, low cost and small size are important. The circuit readily lends itself to implementation in either a discrete component, hybrid or monolithic integrated circuit.

AN INITIAL ASSESSMENT OF THE CURRENT LIMITATIONS IN VIRTUAL MANUFACTURING TECHNOLOGY

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Abstract

This report presents and initial assessment of the limitations in Virtual Manufacturing Technology. It provides a working definition of Virtual Manufacturing, including an enumeration of the hoped-for benefits from Virtual Manufacturing. The definition is broken into various aspects, and technologies are identified for each aspect. The maturity of each of these technologies is rated. Each aspect is ranked according to how well the identified technologies cover the Virtual Manufacturing vision, the maturity of those technologies, and the potential impact the Virtual Manufacturing Initiative could have. Further work is required to prioritize which high impact items are most desirable to pursue.

22-KHZ VOCALIZATIONS AND STRESS IN RATS

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Abstract

Rats sometimes emit 22 kHz ultrasonic vocalizations in response to stressful stimuli. We examined the contexts in which this vocalization occurs as well as the physical characteristics of this vocalization in order to investigate the usefulness of 22 kHz calls in the evaluation of AF-relevant stressors. We digitally recorded and analyzed rat ultrasonic vocalizations in several contexts. In our investigations, rats vocalized in response to acoustic startle stimuli, in response to light touch by humans, and when isolated and undisturbed for long periods. The basic structure of the vocalizations appears to be similar in all these situations, although the rate of vocalizing varies widely across these situations. High-fidelity recordings were made of rat ultrasonic vocalizations in the acoustic startle testing paradigm in order to perform detailed analyses of the physical characteristics of these signals (e.g., intensity, frequency modulation, onsets and offsets), and to evaluate the relationship between these acoustic parameters and characteristics (such as intensity) of stress-inducing stimuli.

INVESTIGATION OF FUEL NEUTRALIZATION AGENTS

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ABSTRACT

This study involved an investigation of fuel neutralization (FN), i.e., the rendering of spilling or spilled fuel non-burnable, extending the time to reignite, and/or facilitating the washing away of spilled fuel. FN agents which were studied were subjected to ignition and burn-back testing, chemical oxygen demand (COD) testing, and biological oxygen demand (BOD testing. The combination of these tests provided information about the FN capabilities as well as the environmental impact of the agents. This report reviews the experimental procedures used, the results obtained, and evaluations still pending, and gives conclusions based on work to date and recommendations for future work.

Nonmechanical microscanning using optical space-fed phased arrays

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Abstract

A method for microscanning in imaging sensors is developed that allows liquid-crystal beam steerers to be used as nonmechanical microscan devices. This submicroscanning method involves using liquid-crystal beam steerers to shift images on a focal plane array by a fraction of the amount used in typical microscan methods. Interpolation techniques based on interlaced sampling are used to produce images free of aliasing out to twice the Nyquist frequency determined by the focal plane array. Since a continuous phase ramp is produced by the liquid-crystal beam steerer, dispersion effects due to the grating-like nature of the devices are avoided. Simulations for both one- and two-dimensional cases are presented, as well as experimental results using a 3- to 5-μm imaging sensor and a liquid-crystal beam steerer designed for 1.064 μm operation.

ANALYSIS OF A GENERALIZED POLARIZER LAYER FOR INFINITE ARRAYS OF ANTENNAS ON PROTRUDING DIELECTRIC SUBSTRATES

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Abstract

In this paper, the solution for a near-field polarizing layer facing an infinite array of antenna elements printed on protruding dielectric substrates is described. The analysis of the polarizer is accomplished by using Floquet expansion modes for expressing the field components, and the method of moments to enforce the conditions on the printed currents. The analysis and code are capable of representing fairly general single-layered polarizer geometries (planar in x and y) with currents printed in both the x and y directions, and with a periodicity identical to that of the array. Numerical values for the element active impedance and axial ratio are presented for a design with circular polarization characteristics positioned on top of arrays of dipoles with straight and bent arms operating in the transmit mode. Reflection coefficients from arrays of dipoles and microstrip patches illuminated by a plane wave are also calculated.

Integration of J-MASS With MSTARS

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Abstract

The J-MASS architecture is a relatively new modeling system designed to support engineers, model developers, analysts and decision makers. It implements a series of standards and provides software tools to support the development, configuration, operation and analysis of models and simulations at varying levels of complexity and detail. MSTARS (Modular Simulation Tools and Resources) is a joint project being conducted by WL/MNSH and WL/MNMF using a collection of missile simulation and analysis tools that is based on the Modular Missile Simulation (MOMS) taxonomy currently also under development by the two branches and based on the J-MASS simulation architecture. The architecture is being developed at Wright Patterson Air Force Base by ASC/RWWW and WL/AAWA-1. J-MASS is written in the object-oriented DOD-standard language, Ada, and is designed to be transportable between different hardware configurations and to operate with any workstation using a Posix-compliant Unix operation system. The initial capability of J-MASS is limited compared to the total system specification,but a Fall 1993 release will provide functionality throughout the SSE, allowing a user to log onto J-MASS and develop components, assemble them into models, configure a simulation scenario and place players within the scenario, and to execute the simulation and analyze the results through post-processing. However, at the present time the WL/MNSH and WL/MNMF branches are studying the new architecture to ascertain how the current 3DOF and 6DOF missile code can be integrated with the recommended architecture.

ANALYSIS OF A DETECTOR TEST STATION AND THE PERFORMANCE OF A VISIBLE LIGHT PHOTON COUNTER

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Abstract

There were two unrelated areas of research performed at Phillips Laboratory and summarized in this report. Accordingly, this paper is divided into two parts to reflect the different research projects.

The first part describes the analysis and evaluation of a test station designed to collect performance data for CCD's and other focal plane array detectors. The station was purchased from a vendor but had never been used. An attempt was made to make the test station operational. Unfortunately, whereas the hardware appears to be useful, the software that runs the system was determined to be essentially nonfunctional. A detailed analysis of the deficiencies is given along with suggestions for bringing the station up to operational levels.

The second area of research was testing the performance of visible light photon counters (VLPC) which have recently been developed by Rockwell International. A special purpose test station was designed and constructed. The resulting data collected shows VLPC's to be intriguing devices with possible difficulties related to quantum efficiency and response time. More data is necessary in these areas.

CALIBRATION TECHNIQUES FOR BREMSSTRAHLUNG X-RAY SOURCES WITH END-POINT ENERGIES OF 60-160 KEV

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ABSTRACT

This work extends the calibration of a low energy (0-160 keV) bremsstrahlung X-ray source over a range of anode voltages from 50 to 160 kV. Analytical and experimental techniques have been developed which provide a high-level of confidence in the dosimetry used at these higher spectral energies. Analysis techniques using the PHOTCOEF and CEPXS electron-photon transport codes were accurate to within 30% when compared with experimental intensity measurements using a calibrated X-ray vacuum diode. PMOS FETs, used as total dose sensors, validated a scaling factor technique for computing dose rates at "high" X-ray end-point energies to PIN diode calibrated dose rates from spectra with end-point energies below 50keV. Using these techniques, the dosimetry over the entire energy range (20-160 keV) was accurate to within 10% when correlated to the ^{60}Co standard.

SPACE SYSTEM SURVIVABILITY AND DEMONSTRATION WITH C++

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Abstract

This paper discusses a c++ implementation of a simulated system which consists of arbitrary offensive and defensive objects. The purpose of the simulated system is to investigate the efficacy of weapons, sensors, battle management and communication system as well as the effect of policy and strategy. The system being studied is not restricted to the space system survivability problem. It can simulate any arbitrary complex system consisting of different objects interacting with each other. An object-oriented approach to the above problem was previously developed and is called Advanced Simulation Programming Environment (ASPEN). ASPEN is already implemented in Fortran. We decided to study the c++ implementation of the ASPEN framework because c++ supports all the object-oriented characteristics like encapsulation, polymorphism and inheritance.

AUTOMATIC TEST INSTRUMENTATION PROGRAM GENERATION

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Abstract

Aerospace system testing is a highly complex and dynamic process. Requirements are constantly changing, even as a test progresses. Handling data from aerospace tests must adapt to these changes. The algorithms to process data are typically complex, due to the variety of applicable algorithm classes and the large number of channels which must be managed. Furthermore, the processing throughput and response times require a parallel processing approach. A software system was developed to address these issues. The Transient Data Analysis System automatically generates test data processing systems for parallel processors from high level specifications. The process is dynamic in that the processing algorithms executed by the system can be changed at any time during execution.

LOCATION AND IDENTIFICATION OF UNEXPLODED ORDNANCE WITH GROUND PENETRATING IMAGING RADARS, INFRARED (IR) IMAGING, ACOUSTIC IMAGING SONARS, AND ELECTROMAGNETIC INDUCTION METHODS

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Abstract

At least 259 former military sites across the United States have aging munitions buried beneath them. Explosives, or unexploded ordnance (UXO), have already been found in suburban neighborhoods, public parks, and even college campuses. These UXOs range from hand grenades, antitank mines, bombs, and artillery shells to several tons of TNT.

Although toxic chemicals are also hidden at hundreds of other sites, this work is limited to cleanup of UXOs at current and abandoned military sites. The work described in this paper is a continuation of studies initiated last summer in the SFRP, and will result in proposals for development of sensors for locating and identifying buried ordnance. These sensors are ground penetrating imaging radars, acoustic imaging sonars, infrared (IR) imaging, and electromagnetic induction methods.

Military ranges have terrain or soil profiles which vary because of relative water content, types of soil, and present of other UXOs. These variations, which also change daily and seasonally, require the use of more than one sensor at a given facility or range. Descriptions of sensors provide a base for finding and identifying the buried ordnance.

VISUALIZATION OF RAT BRAIN

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Abstract

The anatomy presented by the brain is quite complex, especially at the histological level. Computer visualization of brain anatomy could facilitate various facets of brain research being performed at Armstrong Laboratory. Three areas of computer-based brain visualization were developed during the summer research period at Armstrong Labs: 1) methodology for building a digital brain atlas, 2) techniques for 3-D mapping of brain grafts, and 3) an MRI-based volume reconstruction of a rat head. These visualization approaches utilized microscopy and computer resources both at Trinity University and Brooks AFB. Computer networking capabilities were expanded to expedite transfer of binary digital images between Brooks and Trinity. Visualization software at both sites were explored to maximize the software's utility for AL/OER research efforts. A joint research proposal to the NIH Human Brain Project was prepared and submitted. Collaboration was initiated with the RIC group at the University of Texas Health Science Center San Antonio for the purpose of acquiring MRI data of rat. Numerous computer visualizations were constructed from AL/OER data which in turn have suggested new research approaches and possibilities.

An Intelligent Tutoring System Architecture for Schematic Knowledge

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Abstract

This paper describes a general tutorial architecture for schema-based expertise. Development of tutorial architectures applicable to classes of cognitive tasks is an important step in reducing the development costs of ITS's. Schema-retrieval is a category of cognitive task described in the psychological literature and identified in protocol analyses of problem solving in such varied domains as landlord/tenant law, grasshopper infestation control, and fire fighting.

This paper describes a three-step model of schema-based problem solving derived from protocol analyses. A general architecture for tutoring schema-retrieval skills follows directly from this model. The expert model consists of the elements necessary for the schema-retrieval process, the student model is a subset of the expert model, and a curriculum is an ordered partition of the expert model together with ancillary presentation information.

The general architecture was implemented in a prototype domain-independent tutorial shell called TASK. A tutor for the domain of grasshopper infestation control was partially implemented in TASK. While time limitations precluded completion of the tutor, the initial implementation indicates the feasibility of a reusable architecture for tutoring schema-retrieval skills.

OBJECT-ORIENTED FORMAL SPECIFICATION USING REFINE: A FEASIBILITY STUDY

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Abstract

This paper proposes object-oriented extensions to the REFINE specification language which will facilitate transformation of REFINE specifications into C++ programs. The advantages of this approach are: 1) existing REFINE specifications may be enhanced through interfaces with C++ applications, 2) an integration of object-oriented, logic and functional specification methodologies is achieved, and 3) object-orientation provides support for parallel execution in a natural manner which will allow REFINE specifications to be transformed into parallel programs where appropriate.

INFLUENCE OF PENETRATOR AND TARGET PROPERTIES ON PENETRATION MECHANICS

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Abstract

A previously developed quasi-steady wave mechanics model for penetration of structural targets is modified to include an improved model for the initial and terminal transients. The improved model is then utilized in the parametric study of the influence of penetrator and target properties on penetration depth. The wave mechanics model not only predicts the trends in penetration with variation in these properties, but it also delineates the kinematic mechanisms that are responsible for these trends. It is shown that the combination of high penetrator strength and low target strength produces a local maximum in the plot of penetration depth versus impact velocity. The wave mechanics model shows that the observed decrease in penetration depth with increasing impact velocity is due to flow initiation in the high strength penetrator. For high strength targets, the strength of the penetrator is shown to have little influence on penetration depth. However, for low strength targets, increased penetration results from increased penetrator strength. The effect of penetrator L/D on the ratio of penetration depth to original penetrator length is shown to be very pronounced for L/D's less than 6 but diminishing to near insignificance for L/D's greater than 12. The wave mechanics model shows that the L/D effect is due entirely to the initial and terminal transients. The effects of target strength, penetrator strength, and penetrator density on penetration depth into concrete targets is also presented.

SYSTEM SUPPORT FOR THE SPPD PARALLEL ARCHITECTURE

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Abstract

The SPPD parallel system architecture represents an inovative approach to high-speed digital signal processing. The architecture consists of 16 Texas Instruments C30 32-bit processors with 60ns cycle times and an inovative system of global memory access busses and processor control circuitry. Efficient use of this architecture requires robust run-time software system support. This project proposed a set of operating system requirements for real-time applications on the SPPD architecture, reviewed the existing SPPD operating system (monitor) against these requirements, and finally designed and implemented an operating system prototype which addressed the shortcomings of the existing system.

LARGE STABLE SECOND-HARMONIC COEFFICIENTS IN CORONA-POLED POLYMERIC THIN FILMS

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Abstract

Second-harmonic generation (SHG) and spectroscopic absorption measurements were made over a 15-month period to study the nonlinear-optical thin-film properties of an azo-dye attached polymer in which the dye chromophores were oriented by corona poling. Stable values of the nonlinear optical coefficient d_{33}, for the fundamental of 1.064 μm, were as high as 68 pm/V. The stabilized order parameter of 0.51 found for the chromophores is to our knowledge larger than any reported for guest-host or chromophore-attached polymer glasses. A series of 10 copolymers were synthesized in which the concentration of the azo-dye monomer was varied from 10% to 100%. SHG and spectroscopic data were taken to determine the effect of azo-dye number density on order parameters and d_{ij} coefficients.

SHG and spectroscopic absorption measurements were also taken on guest-host polycarbonates and guest-host poly(methyl methacrylates) poled under high pressures of carbon dioxide.

Some Suggestions for the Engineering Model of Unsteady Flow in a Cavity

George D. Catalano

1.0 INTRODUCTION

Flows past cavities continue to be of considerable interest to the aerodynamic research and development communities. From a basic research point of view, the flow past a cavity presents challenges to the turbulence investigator because of the complex interaction of fluid dynamic and acoustic phenomena. From a development perspective, the aerospace engineer is confronted with a challenging flow field to predict with any degree of confidence.

Research and development efforts in this area can be divided into three broad categories: experimental investigations, acoustic solutions, and Navier-Stokes equations. Dix[1] has performed an extensive experimental investigation at Arnold Engineering Development Center (AEDC). The data obtained was used to validate Navier-Stokes solutions such as those published by Om, Baysal, Rizzetta, Suhs, and Dougherty[2-7]. Unfortunately computer time on the order of 100 cpu-hr of a multiple-cpu, parallel processing, Class VI computer was required. Suhs[5] subsequently reduced the computational time to 20 cpu-hr by applying a thin-layer viscosity approximation and assuming that the cavity centerline is a plane of symmetry. However, the results did not include a computed spectrum, and as a result cannot be used to estimate the forces acting on the structure of the cavity. Acoustic theories have been used in an attempt to predict the spectrum. Unfortunately, such theories can be used only to predict the natural frequencies based on the dimensions of the cavity without predicting the magnitude of the pressures that occur at these frequencies. Caruthers and Raviprakash[8] have undertaken a parametric study of the acoustics of 2-D rectangular cavities exposed to a subsonic external flow using a panel method. Bauer and Dix[9] have taken a different approach developing a simple mathematical model (called the Cavity Acoustic Prediction Code, or CAP Code) with the intent of developing a means of predicting at least a first order estimate of both the frequency and amplitude of the tones occurring in a cavity. The CAP Code model has served as the starting point for the present investigation.

The Preliminary Numerical Results and Mathematical Analysis for Least-Squares Finite Element Methods for incompressible Flow

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Abstract

Since the beginning of the 1970's, people have developed mixed finite element methods for incompressible flow. Engineerers and mathematicians have achieved great results in this field. The Galegin Method solves this elliptic boundary problem successfully. But the velocity and pressure interpolations are required to satisfy a LBB condition which precludes many natural elements. Over the past 20 years, most mathematicians and engineers believed this to be necessary. In this research, a least-squares method for these problems is proposed. This method leads to a minimization problem, the divergence free condition is no longer forced to be zero but is minimized with another equations. And thus it is not subject to the restriction of the inf-sup condition. Piecewise linear elements or piece quadratic element with equally order interpolation can be applied for both the approximation functions and the test functions. Thus simplest and natural elements are easy to program. By the analysis and numerical tests this kind methods achieve optimal rates of convergence in L-2 and in H-1 norms.

There are two parts in this report, analysis in least-squares finite element of stress-velocity-pressure version is in part one and the numerical experience for the vorticity-velocity-pressure version is in part two.

SPECIMEN SIZE EFFECTS ON FRACTURE PARAMETERS FOR SOLID PROPELLANT MATERIALS

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Abstract

Two dimensional finite element elastic and inelastic analyses were performed on solid propellant tension specimens to compute the J-integrals. Single-edge notched specimens of constant width and thickness were studied. The lengths of the specimens were varied to study the size effect. A wide range of crack depths was used for a given specimen length. The mode I stress intensity factors for various specimen geometries were calculated from the elastically computed J-integral. Experimental stress-strain curve was used to perform the inelastic analyses. For a nonlinear material with linear strain hardening, two dimensional plane stress inelastic analyses were performed to compute the J-integrals and the load-deflection curves. The specimens were assumed to be thin so that a plane stress representation could be justified. From the initial slopes of the load-displacement curves, the elastic compliance of specimens of different lengths as a function of the crack depth was determined. The J-integral and the load-displacement curves were used to calculate the "eta" factors for various specimen sizes as a function of crack depth. These factors can be readily employed to establsh an approximate single specimen procedure for J-integral calculations. Of particular significance is the assumed incompressibility of the solid propellant material which was modeled by assuming a Poisson's ratio approaching 0.5 for both elastic and inelasic analyses. Comparisons have been made wherever possible with analyses with Poisson's ratio of 0.25, which corresponds to common structural materials.

A STUDY FOR PRODUCT DESIGN, MATERIALS, SELECTION, PROCESSES, AND INTEGRATION USING LEARNING APPROACHES

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Abstract

The relation on product design, materials selection, and processes has been studied. The procedures for design, materials selection and processing is summarized in this study. To design a product, material properties and materials processing has to be considered simultaneously. The study shows that association among design, materials, and processes must be built and identified. Several learning approaches that can be used as tools for building an inductive and deductive coupling system for materials research are discussed. Future research opportunities in this area are also presented.

Lidar and Atmospheric Monitoring

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Abstract

Under the assumption of elastic scattering we denote by E(R) the detected radiative energy of a well aligned laser received from a target plane at a long range R.

In most cases R can be recovered given E.

If $E(R)R^2$ is very small or very large compared to the range, then there is no atmospheric turbulence near the target.

If $E(R)R^2$ is neither, then the atmosphere near the target is at worse turbid.

A REVIEW OF FLAIL AND WINDBLAST INJURIES

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Abstract

During an open seat ejection escape from a disabled aircraft, a crew member is exposed to high velocity airstream abruptly. Severe limb flail (windblast) injuries can occur as a result of this exposure. Typical injuries are described as muscle tears, joint dislocation and/or long bone fracture. This report reviews various aspects of limb flail injury from available literature and reports. Topics include injury description, statistics, mechanisms, and measurements of flail loading. To fully understand the transient physical event of flail injuries, a finite element modeling effort is planned. Mechanical properties of relevant biological soft tissues and hard tissues are also reviewed and summarized in this report and they will be used as the database for continuing modeling effort.

INTEGRATED COMBAT TRAINING

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Abstract

This report examines the needs and opportunities for using simulation in the service of integrated combat training. Two separate but related needs are foreseen: 1) continuing combat unit training in a decreasing resource environment, and 2) possible surge training to meet presently unforseen contingencies.

Clearly, simulation relates to simulators: devices used for training, but it does not stop there. Training simulation, properly conducted can support other important needs: 1) modeling of crew activities, 2) identification of operational capabilities and limitations in new uses of old systems, 3) validation of future weapons systems operational requirements, 4) evaluation of future designs, either for modernization of existing systems or acquisition of new systems, and 5) support of preparatory analyses for instructional systems development.

No single training environment is by itself ideal or self-sufficient for assuring combat readiness. The most effective training regimen combines a variety of experiences, each of which provides its own unique contribution to the overall training objective. To make this mix of training experience truly effective, the individual must be able to integrate that experience in a coherent manner and relate it to wartime combat requirements.

The utility of using constructive models for training applications was examined. AASPEM allows user-specified Pilot Decision Logic. TAC BRAWLER (TB) models pilots' situational awareness and value-driven decision making, using a production system approach. TB seems especially well-suited to showing the impact cognitive skill training can have on system performance and mission outcomes. TB could: 1) demonstrate training goals, 2) illustrate what factors are important and to what degree, 3) reinforce the importance of learning task priorities, and 4) show the potential results of disciplined practiced.

To better tailor such production systems to training applications, is recommended that: 1) the mental model's logic structure be documented in terms of a concept map, 2) the task management strategy be explicitly captured, 3) areas for incorporating skill progression-regression into the model be identified, and 4) workload considerations be expanded.

Gerald P. Chubb OSU Dept. of Aviation

AUTOMATE: A RESEARCH PARADIGM TO STUDY COLLABORATION IN MULTIDISCIPLINARY DESIGN TEAMS

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Abstract

The multidiciplinary design team approach has several advantages over conventional approaches to design. Yet is also has several potential drawbacks. These drawbacks include: miscommunication, lack of coordination, and misanalogies. A research paradigm was developed that examined these issues. The paradigm was based on the Stasser's (1992) hidden profile research. A fictitious design rationale is presented to subjects and contains the shared information. Each individual also receives a guidebook based on information from their own specialty or discipline. This guidebook contains the unique information. Information sharing can be assessed by examining the design rationales subjects provide for their design choices. Future research questions that can be addressed with this paradigm are discussed.

AUTHOR NOTES: The author would like to thank Mike McNeese, Cliff Brown, Jon Selvaraj, Randy Whitaker, and Brian Zaff for their help and support on this project.

Styela plicata AND *Molgula occidentalis* (UROCHORDATA: ASCIDACEA: STOLIDIFERA) IN ST. ANDREW SOUND, FLORIDA

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Abstract

Stolidiferan sea squirts, *Styela plicata* and *Molgula occidentalis* collected in the eastern arm of St. Andrew Sound, northern Gulf of Mexico, had filtration rates of about 69 L d^{-1}/animal in phytoplankton concentrations of 4-9 X 10^6 cells L^{-1}. Filtration rates and efficiencies were calculated by measures of water clarity changes over time using time-lapse photography and the presence/absence of bioluminescence in experimental v. control aquaria. Fluorescein and rhodamine B dye observations confirmed filtering activity. Microscopic examination of tunicate-filtered water for the presence of living phytoplankton cells and sediments confirmed that filtration was efficient, and that increased water clarity in experimental aquaria over time was not attributable to the settlement of suspended sediments.

The number of *S. plicata* and *M. occidentalis* in the sampling area was estimated to be 0.7 individuals m^{-2}, with a total population of about 846,000 of each species. Given obviously unrealistic assumptions of uniform phytoplankton distributions and availability; uniform distributions of tunicates; stable and continuous feeding rates and efficiencies; and invariable environmental conditions, the 2 X 10^6 m^3 (2 X 10^9 L) of water in the sampling area could be cleared by the two species in about 17 d. In spite of probable order-of-magnitude errors in estimates, the two species of sea squirts clearly play an important trophodynamic role in the ecology of St. Andrew Sound, and likely do so in other favorable, high salinity coastal ecosystems.

High and efficient filtering rates coupled with the known ability of ascidians to assimilate heavy metals (up to 10^9 above ambient concentrations), strongly suggests that sea squirts may be usefully employed as biological indicators/ monitors in anthropogenically impacted marine ecosystems. Ascidians may also provide a low-cost alternative to microbiologically-mediated environmental bioremediation. Certain species may be harvested for the extraction of strategic metals.

The major, possibly only significant predator of *S. plicata* in St. Andrew Sound is the Florida crowned conch, *Melongena corona*, which also feeds upon the tunicate's possibly mutualistic mussel symbiont, *Musculus lateralis*. The relationship between sea squirt and mussel may be reciprocally beneficial in terms of facilitating the disruption of an animal-water interface boundary layer, which in non-turbulent conditions may impede the acquisition of food and oxygen to the species pair.

SOURCES AND PATTERNS OF REACTION TIME FLUCTUATION USING A CONTINUOUS SUSTAINED REACTION TIME TASK

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Abstract

Fluctuations in attention through time was operationalized in terms of reaction times to continuously presented stimuli. Auditory and visual stimuli were presented for six or 16 minutes, at an isochronous rate varying between 800 and 2000 milliseconds. Six of the eight subjects were capable of adequately performing the task, which required high rates of continuous vigilance. Diverse trend patterns were observed, but overlaid on the trend were local fluctuations, as indexed by autocorrelational patterns. These appeared to be strategic rather than strictly endogenous. Evidence of periodicity in the 3 to 5 minute range was found, but this evidence will require replication. A PRP (psychological refractory period) effect was found, such that subjects could not keep up with fast stimulus presentation rates even when response times were consistently less than this presentation rate on blocks with slower presentation rates.

AN APPROACH FOR UNIFIED SENSOR MANAGEMENT DESIGN

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Abstract

Modern aircraft are sophisticated machines with increasing numbers of sensors that generate more data and operate in a greater variety of modes than ever before. To improve the performance of these machines a sensor manager, in the words of Stan Musick, is necessary "to direct the right sensor to the right task at the right time." The design of a sensor manager is difficult. The common approach is to use ad hoc methods to develop rules which direct the sensors' operation under various conditions. The goal is to develop a technique that unifies the sensor manager design. This report examines one such technique, the Analytic Hierarchy Process. The author concludes that a modified version of the Analytic Hierarchy Process is a good candidate for the job of design integrator for the development of a sensor manager.

Computer-Aided Polymer and High-Energy Density Material Design

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Abstract

This research focuses on the use of computational chemistry techniques to predict properties for polymers and high energy density materials (HEDM) currently under experimental investigation by Air Force scientists. Molecular mechanics (MM) calculations were successful in predicting structural parameters for poly-oligomeric silsesquioxane (POSS) polymers. The MM calculations also suggested experiments for further probing the structure-property relationships of POSS polymers. The PM3 semi-empirical, quantum chemical method provided a quick and accurate estimate of the heats of formation (and hence I_{sp}) for HEDM targets, particularly when comparing related families of molecules. Based on the results, several recommendations are made for profitable exploitation and extension of this research.

STRUCTURE AND COMPOSITION CHARACTERIZATION OF GaAs, AlGaAs LAYERS AND SUPERLATTICES GROWN ON GaAs BY MOLECULAR BEAM EPITAXY

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Abstract

High resolution x-ray double crystal diffractometry was used to characterize thin film layers grown on III-V monocrystalline material by molecular beam epitaxy. In particular, the thickness, composition and structure of epilayers and superlattices grown on (001) GaAs were determined. GaAs and $Al_xGa_{1-x}As$ epilayers, high electron mobility transistor structures and quantum well superlattices were characterized by evaluating rocking curves and performing simulations based on dynamical x-ray theory. Data was also obtained to support projects which focus on the low temperature growth process of GaAs on GaAs and the relationship between growth conditions and structure of III-V films.

ENTERPRISE INTEGRATION IN IICE WITH ONTOLOGY CAPTURE

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Abstract

The task of improving the performance of large complex processes by managing the interactions among participants leads to integration of enterprises. Within the context of Information Integration in Concurrent Engineering (IICE) practices, ontology sharing by different enterprises is a means of achieving integration. To share ontology is to capture it while in transition from As-Is to To-Be. This can be done by using a functional form for ontology given by the expression <Form, Structure, Intention> ---> Implication at t1.

Development and testing of DNA probes specific for *Escherichia coli* strain 0157:H7, *Ureaplasma urealyticum*, and *Mycoplasma hominis*.

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Abstract

Escherichia coli strain 0157:H7 is enterohemarrhagic causing severe bloody diarrhea in humans. It is often contracted by ingestion of contaminated hamburger meat. Present methods used for diagnosis of this pathogen are time-consuming, expensive, and not of great sensitivity. Attempts to develop a DNA probe for this plasmid-borne virulence were initiated to circumvent these problems and to provide better patient care.

Ureaplasma urealyticum and *Mycoplasma hominis* are among the smallest of all free-living organisms. They have been implicated as the etiologic agent for a variety of disease conditions. DNA probing systems, which are specific for these suspected pathogens, have been developed. These probes were applied using *in situ* hybridization and DNA amplification assays. Approximately 80 clinical specimens were used to test the accuracy of these systems. The results obtained were in complete agreement with results obtained from cultural diagnosis.

AN ANALYSIS APPROACH TO DETERMINE QUALITY FACTORS OF LARGE, COMPLEX CAVITIES

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Department of Engineering
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Abstract

An analysis approach to determine quality factors (Q) of large, complex cavities is proposed. It consists of looking at apertures and other objects as individual sources of cavity Q. These sources of Q contribute to the total Q linearly if they are not in close proximity to each other, cavity walls, corners or edges. Analysis of the individual sources is done assuming that the energy density in the cavity is uniform and the fields away from the walls are completely random so that the fields incident on the walls can be viewed as a composite of several local plane waves of arbitrary polarization. The technique is illustrated analytically with large apertures, both loaded and unloaded, small apertures, and a large area of ferrite absorber. A discussion on using existing computer programs and how they can be modified to calculate Q for other classes of objects is also included.

DESIGN OF AN INTERFACE BETWEEN THE GENERIC INTELLIGENCE PROCESSOR (GIP) AND A NATURAL LANGUAGE UNDERSTANDING SYSTEM

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ABSTRACT

The goal of this document is to specify the design of an interface between a data extraction system called the Generic Intelligence Processor (GIP) and a natural language understanding (NLU) system called the Probabilistic Language Understanding Model (PLUM). The interface will provide a mechanism for processing natural language fragments through PLUM in the GIP environment. The central design strategy for this interface is to make little or no changes to the existing systems, namely, GIP and PLUM.

Resolution Enhancement of Passive Millimeter-wave Imaging

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Abstract

Although passive millimeter-wave imaging is capable of operating under adverse conditions and provides the advantage of stealth, its poor resolution severely limits its applicability in practice. The problem of resolution improvement for a passive millimeter-wave imaging system is investigated. The feasibility of significant image resolution improvement is studied. A new differentiation-integration deconvolution (DID) algorithm is proposed for resolution improvement on images containing extended targets and is tested through extensive simulations. A criterion for measuring super-resolution is also presented and shows that our proposed DID algorithm improves the resolution of test images by 2-3 times.

TERRAIN-SCATTERED RADAR CLUTTER SUPPRESSION USING SIGNAL RESTORATION

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Abstract

This report presents research results on a new method for the suppression of terrain-scattered clutter due to intentional jamming of the radar footprint. The new method applies signal restoration processing on the conventional beamforming output. The temporal processing of the received radar signal attempts to restore the known properties of the transmitted radar waveform. This approach relies on the transmitted radar signal having coded phases, such as a discretized chirp or polyphase waveform. The properties of the code are used to distinguish the desired radar return from the jamming and clutter interferences. Because of the assumed prior knowledge of the transmitted waveform, it is not necessary to have an auxiliary record of the jamming signal. The signal processing is also iterative, requiring no sensor correlation matrix formation or inversion.

A Comparison of Biasing Options in the Laser Multiphoton Ionization Detection of Methyl Radicals in a Filament-Assisted Chemical Vapor Deposition Reactor

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Wright State University

Abstract

An apparatus and procedures were developed for the detection of methyl radicals in a filament assisted chemical vapor deposition reactor operating with methane/hydrogen gas mixtures similar to those used in the generation of diamond-like carbon films. The apparatus was designed to detect small transient currents as the focussed output of a tunable dye laser ionizes methyl radicals between a hot filament and a deposition substrate. The current design incorporates the use of an electrode pair for ion collection, that may be translated between the filament and substrate. Results from two circuit designs with different bias geometries for ion collection are presented.

EXPERIMENTAL STUDIES OF SECOND-HARMONIC GENERATION IN GLASS

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Abstract

Focusing intense laser light along with some of its second harmonic into a glass sample transforms the glass into a frequency doubler. We present a new method to measure the optical phase shift between the second-harmonic beam used to seed the glass and the second-harmonic beam subsequently produced by the glass sample. Determination of this phase shift is essential for understanding the growth dynamics of the effect, and its value can discriminate between proposed theoretical models. We also investigated and characterized a second, non-optical technique to transform an ordinary piece of glass into a frequency-doubling element. This second method relies on electric field poling in which a thin sample is heated to ~300 °C and immersed in a strong dc electric field (3 kV/mm). After cooling the sample in the presence of the field a permanent second-order optical nonlinearity is induced in the glass. We studied the polarization properties of the induced nonlinearity to determine if the effect arises from a dc field locked inside the material. The polarization studies show that the optical nonlinearity cannot be explained by simply invoking an internal dc electric field.

Characterization Of A CdTe-Doped Fiber and The Design of A Wave-Shaping Circuit for Optical TDMA Network Implementation.

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Abstract

A cadmium telluride (CdTe) optic fiber, and a fast electronic switching circuit, were constructed and studied for use in an Optical Time-Domain Multiple-Access (OTDMA) network. The fiber was to be used in constructing a broad-band optical amplifier. The switching circuit was integrated into a lithium niobate electro-optic carrier modulator.

The fiber core had a CdTe-glass hyperlattice structure. The diameter of the glass-core was 20 microns surrounded by a CdTe cylindrical ring of thickness 20 armstrongs. The absorption and transmission spectra of the fiber were characterized. The results were compared with those of bulk CdTe with remarkable difference between the two. The absorption spectra for the fiber was broad-band and was red-shifted in comparison with the bulk.

The switching circuit had fast rise- and fall-times of 2 nanoseconds and converted TTL logic gate levels (as inputs) to 10 volt, 200 milliamp output levels for the electro-optic modulator.

PLIF Images of Supersonic Jet Mixing in the Wright-Patterson AFB Supersonic Combustion Facility

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Abstract

Some experimental measurements are described which resulted from an AFOSR sponsored interaction between Dr. J.F. Driscoll, Dr. A.S. Nejad of Wright-Patterson AFB, and other researchers in the Advanced Propulsion Division. The goal of the work was to study the mixing of a turbulent jet of gas that is injected coaxially into a supersonic air stream. A unique supersonic wind tunnel facility was used that was developed by, and is currently operated by Dr. Nejad. A circular, underexpanded sonic jet issues along the centerline of a Mach two wind tunnel. The injector consists of a splitter plate with a circular orifice on centerline; this design simulates a fuel injection strut in a scramjet combustor, and it was selected because the simplicity of the boundary conditions allow it to be modelled using existing numerical codes. The jet fluid is helium which is seeded with gaseous acetone. A Planar Laser-Induced Fluorescence (PLIF) imaging system was used to record images of the acetone fluorescence during the mixing process. Several methods were considered to reduce the data in order to extract images of the jet mixture fraction (f), which is the fundamental parameter of interest in mixing models.

Images of the mixing process were obtained for three different injection conditions and for several different imaging locations, including the near field and the far field of the jet. Values of the pressure ratio, defined as the jet exit static pressure to the air static pressure, were selected to be one, two and five. Results indicate that acetone fluorescence is a useful method to identify the shock wave structure and to quantify several parameters that characterize the mixing process. These parameters include the centerline decay of the mean mixture fraction, the radial profiles of mean mixture fraction, turbulent fluctuations in mixture fraction, and the eddy structure of the scalar field within the jet. The jet spreading rate is much smaller for the supersonic cases than for typical subsonic jet mixing cases. This difference occurs because several additional physical processes are introduced when the surrounding flow becomes supersonic, including the effects of velocity ratio, density ratio, and compressibility. The images obtained provide a useful set of data that are being used to develop general scaling laws for the supersonic mixing process and to improve existing numerical models of mixing.

The work also revealed that additional research is needed to quantify the pressure and temperature dependence of the fluorescence intensity from acetone at the relatively low pressures of 0.5 atm. and low static temperatures of 166 K (minus 160 degrees F) that occur in the present supersonic airflow. Calibration measurements are needed in a controlled pressure cell in order to properly reduce all to the data obtained to date. Such follow-on measurements will be proposed as a Summer Research Extension Program (SREP).

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FINAL REPORT

TEMPERATURE EFFECTS ON AQ. POLYMER AND BIOPOLYMER SOLUTION VISCOSITIES, AND ERYTHROCYTE SEDIMENTATION RATES AND CELL VOLUMES IN MAMMALIAN BLOOD.

Prepared by: W. Drost-Hansen
Mag. scient. (Ph.D.)
Associate #: 91

INTRODUCTION

After more than 70 years the Erythrocyte Sedimentation Rate continues to be used extensively in clinical and veterinary medicine (especially overseas.) However, the detailed dynamics of the ESR continues to escape a rigorous description although in principle many of the factors which influence the sedimentation process are well understood. The primary factors involved are the tendency for rouleaux formation (reflecting the RBC surface adsorption from the complex, macromolecular chemistry of the blood plasma), the plasma viscosity, shear rate, hematocrit, erythrocyte morphology, and a number of other factors of less direct influence.

We have continued our studies of the ESR over a wide temperature range; thus, while our previous measurements were restricted to approx. the range from 24 ^{o} to 52 ^{o} C, we have now extended the range down to about 8 ^{o}C for number of previously studied species (and a few new species.) At the same time, because of the expected Stokesian involvement of "particle size", we have continued our Mean Cell (RBC) Volume [MCV] measurements (and also Mean Platelet Volume [MPV] measurements) as functions of temperature. These volume measurements are highly useful for delineating the effects of temperature on the osmotic processes involved in volume control of the cell sizes. Finally, because of the importance of the plasma viscosity we have also measured viscosities of aqueous solutions of a variety of polymers: both model polymers (such as Polyvinyl pyrrolidone, Polyethylene oxide and Dextran) and some biochemically important macromolecules (such as Bovine Serum Albumin [BSA], Fibrinogen and Cytochrome-c.) Anomalous thermal responses continue to be observed at the Drost-Hansen thermal transition temperatures (T_k, near 15, 30, and 45 ^{o}C) in nearly all parameters measured!

SCANNING IMAGE PROCESSING FOR OPTICAL REMOTE SENSING

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Abstract

An incoherent two pupil scanning image processing technique appropriate for optical remote sensing applications (e.g., LADAR) has been investigated. By scanning simultaneously with two superposed optical beams, of slightly different temporal frequencies, complex (i.e., amplitude and phase) and/or bipolar spatial filtering operations can be applied to intensity representations of remote objects. The technique is similar in a sense to the way by which computer based post processing has traditionally been applied to incoherent optical images in that an appropriate optical convolution kernel, generated by the two pupil interaction process, is convolved by scanning with object intensity records. The all optical technique, however, is capable of real time image processing, and in many instances may be capable of producing higher resolution processed images than are achievable by computer based post processing alone.

INTEGRATING MULTIMEDIA INFORMATION FOR THEATER-LEVEL COMMAND AND CONTROL

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Abstract

The modern command center must support force-level data fusion (the integration and display of information from a range of sources) to meet the needs of contingency operations. Furthermore, the effectiveness of the information use depends upon improving the integration of information processing capabilities with the cognitively-demanding team planning and decision making tasks of the joint force senior command. Thus, "having the most data" is not an assurance of success in warfare. The leveraging factors in information technology for command support are the ability to present the commander with the *right information* at the *right time* with the *right level of detail*. The user-computer interaction (UCI) design goal is an information interaction concept that balances maximal use of the positive characteristics of the various information presentation and interaction technologies to meet requirements, while minimizing the potential for distractions from the primary tasks. Achieving this balance requires understanding not only the cognitive requirements of the task and the characteristics of the individual UCI technologies, but also the interaction of technologies and the additional cognitive requirements imposed by the introduction of new technological capabilities into the operational environment. One of the principal goals of cognitive systems engineering research is the identification and exploration of these relationships. Ultimately, this research should not only guide the design of new systems, but also provide feedback to drive the development of the next generation of technological resources. In direct contrast to the tendency for "technology push" in advanced systems development, this feedback loop supports *requirements-driven design* and reinforces the links to the human user.

This report investigates the "Data Wall" information presentation concept and its associated interface technologies with respect to their potential contributions to the critical requirements associated with theater-level command and control (C^2) decision making. The paper further highlights the pivotal technological issues and emphasizes the importance of context-specific research to support successful design and development to meet the operational requirements of C^2 decision making.

NONLINEAR BENDING VIBRATION OF FLEXIBLE SOUNDING ROCKETS: AN OPPORTUNITY FOR NONLINEAR IDENTIFICATION

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Abstract

The state of the art in strength and flight stability analysis of flexible sounding rockets during launch and ascent was studied. Although interstage joints and other connections between payload segments are known to exhibit nonlinear displacements with applied moment, allowances for this behavior are not typically made. A simple model of a sounding rocket was devised comprising two flexible beams connected by a rotational spring with stiffness which is both linear and cubic in the displacement. The effect of this nonlinear spring on beam response was studied to form the basis of nonlinear identification studies. A survey of the state-of-the-art of nonlinear structural identification theory was accomplished. Methods to develop and apply nonlinear identification algorithms to beams with nonlinear connections are proposed.

Field-Induced Atomic-Scale Manipulation of Semiconductor, Metal, and Conductive Polymer Surfaces with a STM

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Abstract

The goal of our experiments is to demonstrate the ability to "etch" very fine grooves (a few angstroms in width and depth) on semiconductor, metal, and conductive polymer surfaces using a scanning tunneling microscope (STM). Specifically, our specimens consist of n-type and p-type <111> silicon, gallium-arsenide, gold, and polypyrrol, with air and water being the electrolytes. The motivation behind this work is the theory of field-induced evaporation of surface atoms, i.e., atoms can be removed if an appropriately voltage-biased STM tip is brought close to a conducting surface. A "C" program *drives* the STM tip to a specific location on the surface to be etched making a groove or a ditch. Grooves traced out in a fractal pattern are expected to provide high surface area electrodes necessary to achieve high capacitance. This research may eventually lead to the fabrication of ultra-high-speed quantum devices as well as high capacitance electrodes for high energy density capacitors.

FIBER MATRIX INTERFACE - INFORMATION FROM EXPERIMENTS VIA SIMULATION

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Abstract

This study explores a novel procedure for obtaining quantitative information on the mechanical properties of the fiber-matrix interface in composite materials. The method simulates actual experiments in detail, including fiber breakage, matrix yield and/or cracking, and interface failure. The paper concentrates on two commonly performed experiments, the so-called fragmentation test for metal matrix, and the pushout/pullout test for metal as well as ceramic matrix composites. Based on the documented capability of the technique to simulate actual experimental data, reliable values of interface (homogenized) properties can be obtained. In addition, the simulations provide further understanding of the mechanisms involved during the relevant testing. Although this study presents results from basic problems, the method is general enough to include effects of residual stress, of high temperature environment, of dynamic crack propagation, as well as three-dimensional details of the interface failure process. The potential exists for simulating non destructive wave based techniques aimed at evaluating interface properties.

APPLICATION OF GENETIC ALGORITHMS TO PATTERN THEORY

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Abstract

Pattern Theory is a robust technique for extracting "patterns" or "features" from a function and can be applied to many areas, such as machine learning, image processing, pattern recognition, and logic minimization. Recent efforts have focused on using pattern theory to decompose Boolean functions. However, the computational complexity of the method has currently limited its utility to functions of fewer than twenty variables. Consequently, we are interested in developing algorithms to quickly find variable partitions that lead to small decompositions.

Genetic Algorithms belong to a class of optimization methods which attempt to utilize the evolutionary mechanisms observed in Nature. Trial solutions to a particular problem are generated randomly to form an initial population. Copies of these solutions are made, proportional to the "quality" of the solution, or how well it solves the problem. Genetic operators, such as crossover and mutation, are then used to form a population of new solutions. The goal of this research was to assess the use of genetic algorithms for selecting variable partitions. A simple genetic algorithm is presented and the performance compared to other partition search techniques already in use. Finally, recommendations are made for topics of future research.

COMPUTER MODELING OF ELECTROLYTES FOR BATTERY APPLICATIONS

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Abstract

Computational chemistry and computer simulation has been explored as a means of understanding electrolyte conductivity. The principal software package used in these preliminary investigations was HyperChem (Release 3, Autodesk) which provides an extensive package of semi-empirical molecular orbital methods as well as molecular mechanics and dynamics. The investigations were divided into three areas as follows:

The first involved an assessment of the ability of computational spectral analysis to provide an interpretation of the infrared spectra of salt /electrolyte mixtures. Infrared spectra were computed for six low molecular-weight solvents. Comparison of calculated and experimental spectra indicated relative agreement for principal peak assignments; however, calculated peaks were generally 200–300 cm^{-1} higher in wavenumbers. Possible approaches for further study have been suggested.

The second addressed the importance of the conformation of polymer electrolytes, especially poly(ethylene oxide) (PEO), in relation to conductivity and as a foundation for future molecular dynamics simulation of ion-electrolyte interactions. The structure of PEO containing 8 repeating units was optimized and molecular parameters were calculated for the resulting extended-chain (planar zig–zag) conformation. A 7/2 helical conformation as reported in the literature for PEO was imposed by constraining torsional angles. Energies and other parameters were evaluated by single-point AM1 calculations. It was found that the partial electric charge on the oxygen atoms in the PEO repeating unit was slightly less electronegative for the helical conformation; however, the computed dipole moment of the helical conformation was significantly higher than that of the extended chain while overall energy was approximately the same.

The final area focused on evaluating different synthesis routes for macrocyclic electrolytes. Several macrocyclic structures built by joining four furan rings were modeled and their energies and charge distributions calculated for different bridge groups and substituents. The most planar structure was obtained using an unsaturated bridge group; however, partial charge calculations showed that the central oxygen atoms on the furan rings were less electronegative than the oxygen of a single furan molecule due to resonance stabilization of the entire macrocycle.

ION-MOLECULE REACTIONS AT HIGH TEMPERATURES

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Abstract

A High Temperature Flowing Afterglow was utilized in the study of ion-molecule reactions. Reaction rate coefficients were measured for the following reactions in the temperature range 300-1300 K: $O^- + H_2$, D_2, and CH_4; $O_2^+ + CH_4$.

The system performance was evaluated in terms of changes needed to effect a more durable and reliable instrument. The effects of the high temperatures and cycling to room temperature dictate further design modifications that will be the subject of another paper (in preparation)[1].

Environmentally Safe Propellants:

Synthesis of Polymers for Gelation of Liquid Salt Systems

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Department of Natural Sciences

College of DuPage

Abstract

Poly(acrylhydroxamic acid) and poly(acrylamideoxime) were prepared were prepared by the folloing methods. Poly(acrylhydroxamic acid) was prepared from the reaction of poly(acrylamide) and hydroxylamine in basic aqueous solution (pH $\approx$ 14) at room temperature. Poly(acrlyamideoxime) was prepared from the reaction of poly(acrylonitrile) and hyroxylamine hydrogen chloride and anhydrous sodium carbonate in N,N-dimethylformamide at 75^{o}C.

Binary mixtures of S-HAN-5 with the two polymers were prepared. Poly(acrylhydroxamic acid) is both miscible and compatible, and leads to gelation of the HAN. Poly(acrylamideoxime) appears to be compatible but is not miscible nor did gelation occur in HAN.

Characterization of the polymers have begun. The results of the infrared analysis and the DSC are included. Carbon-13 nmr analysis is in progress. Elemental analysis of the polymers, as well as, impact and friction tests of the binary mixture of S-HAN-5 and poly(acrylhydroxamic acid) are in various stages of progress.

THERMOMECHANICAL FATIGUE OF TITANIUM MATRIX COMPOSITES

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Clarkson University

Brian P. Sanders
Wright Laboratory Materials Directorate

ABSTRACT

The objective of the research is to develop a mechanistic model to study the response and damage development of metal matrix composite laminates under a general thermomechanical fatigue loading. The research consists of two parts. The first part deals with fatigue life prediction of SCS_6/Ti-15-3 metal matrix composite laminates. Damage accumulation and property degradation of each lamina in the laminate are studied. Internal load re-distribution among all the laminae is evaluated from the model of stiffness reduction. It is shown that within the first few cycles, stiffness reduction saturates to a characteristic level which is independent of cyclic and static loading history. As far as the fatigue life prediction is concerned, it is not important to know how the damage is accumulated, or what the stress-strain response is during the first few cycles. The fatigue life is determined by the saturated stiffness and the applied stress amplitude. The predictions of fatigue life agree well with experimental data of $[0/90]_{2s}$, $[0_2/\pm45]_s$ and $[0/\pm45/90]_s$ (SCS_6/Ti-15-3) laminates. The data needed to predict the life of these laminates under variable amplitude fatigue are those of its laminae. Therefore, it is possible to establish a data base for different unidirectional laminae and predict the fatigue life of a laminate based on the data of its laminae and the laminate stacking sequence.

The second part of the research deals with micromechanical analysis of local damage and viscoplastic behavior of titanium matrix composites under a thermomechanical fatigue loading. The present micromechanical analysis is based on Eshelby's solution of an ellipsoidal inclusion [2.1] and Mori-Tanaka's concept of mean field theory [2.2]. The model is applicable to study deformation and stress of a composite under general nonisothermal in-phase and out-phase fatigue loading. Interfacial damage and debonding are represented in the model. Such an analysis make it possible to determine the possible failure modes (matrix failure or fiber failure or combined) under different thermomechanical fatigue loading. The predicted creep behavior of unidirectional composite under a load in fiber direction agrees well with experimental data.

A CONCEPTUAL DESIGN FRAMEWORK FOR CONCURRENT ENGINEERING

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Abstract

This report summarizes important research in the area of conceptual design and outlines a road map for carrying out conceptual design. It studies the impact of concurrent engineering philosophy on conceptual design. A case study is given to illustrate the proposed methodology. Since more than sixty percent of product cost is determined at the conceptual level, the paper emphasizes that feed back from concurrent engineering team should be sought right at the conceptual level. The report addresses the problem of how new designs can be evaluated at the conceptual stage by taking into account manufacturing constraints and field performance data of past designs.

AN ANALYSIS OF THE HIGH ANGLE OF ATTACK AERODYNAMICS OF ARBITRARY BODIES UNDER-GOING RAPID MANEUVERS

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Abstract

Little is known about the aerodynamics of finned missiles at high angles of attack. There have been several analytical approaches and only a few experimental studies. Virtually all high angle of attack research on slender bodies has been concerned with the static aerodynamics. At large angles of attack, a vortex dominated wake forms on the leeward side of the body. During rapid maneuvers (rapid pitching, yawing or rolling), the body and its fins translate through the vortical flow. As a result large, unsteady forces and moments develop. The focus of this study was to develop a quick method for estimating the aerodynamics of rapidly maneuvering bodies. A discrete vortex approach was utilized for its ability to rapidly estimate the gross high angle of attack aerodynamic loadings on finned and unfinned bodies. Significant modification of the aerodynamic loading is observed, and the stability derivatives show large fluctuations for the unsteady motion. The discrete vortex method rapidly determines the flow characteristics of the body, and calculates the total body aerodynamics.

AN SFE-GC METHOD FOR MONITORING THE WEATHERING OF JET FUELS IN SOIL

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ABSTRACT

An SFE-GC on-line procedure for the analysis of jet fuels in a soil matrix was developed. The method has been found to quantitative for the volatile components of jet fuel at the parts per million level. The on-line procedure directly traps the analytes from the supercritical fluid extraction onto the head of the GC column. This is accomplished by using a heated transfer line to transfer the SFE analytes directly to the injection port of a GC during the dynamic extraction of a soil sample. The operating parameters and instrumentation are detailed within this report. GC chromatograms for prepared standard samples are presented.

COMPARISON OF HYDRAULIC AND THERMAL PERFORMANCE OF PAO AND COOLANOL 25R LIQUID COOLANTS

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Abstract

A general method for the comparison of hydraulic and thermal performance of different liquid coolants is offered. Thermophysical property expressions for the variation of density, specific heat, thermal conductivity, and kinematic viscosity with temperature for PAO and Coolanol 25R were developed. The range of temperature for this study was from -54 to 135°C. Based on the results, the hydraulic performance of Coolanol 25R is much better than PAO at low temperatures (below 0°C) and laminar flow regime. In the turbulent region, PAO hydraulically outperforms Coolanol 25R over the entire temperature range. The thermal performance of PAO at temperatures below 61°C and in the laminar flow region, is slightly better than Coolanol 25R. In the low temperature turbulent region, Coolanol 25R thermally outperforms PAO. At other temperatures, the performance of the two liquid coolants are reasonably close and fairly independent of the flow regime.

SPEAKER IDENTIFICATION USING BESSEL FUNCTION EXPANSION OF SPEECH SIGNALS

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Abstract

Identification of speakers using Bessel function representation of speech signals was studied. Coefficients in the Fourier-Bessel expansions of frames of speech with (a) $J_0(t)$, and (b) $J_1(t)$ as basis functions were used as feature vectors. In both cases it was determined that at least 20 coefficients that have the largest magnitude in the expansion were needed to obtain a reasonable quality of synthesized speech. Of the different feature vectors obtained from the expansion coefficients, higher scores for speaker recognition resulted with $J_1(t)$ than with $J_0(t)$. In addition, for the same dimensionality, $J_1(t)$ expansion showed better speaker identification scores than reflection coefficients from linear predictive analysis.

DESIGN AND VALIDATION OF ORTHOGONAL THREE-COMPONENT LDV SYSTEM

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ABSTRACT

The work accomplished at Wright Laboratory this past summer can be subdivided into four major tasks. They included: 1.) the design, fabrication and validation of an orthogonal three-component laser Doppler velocimeter (LDV) system, 2.) the modification of an existing low speed flow facility by adding radial fan blower to provide air flow instead of using compressed air (this allowed for day time running of experiments), 3.) the modification to the fuel injection test section to allow for optical access on all four sides and, 4.) the use and testing of new LDV data acquisition and analysis software. In addition, a Wright Laboratory senior engineer was trained to use this three-component LDV system as part of this effort.

Once the LDV system was built and tested, and modifications were made to the test facility, simultaneous two-component and three-component velocity measurements were made in the flow field surrounding an integrated fuel injector (IFI). The two-component velocity measurements are presented here.

A Framework for Developing and Managing Reusable Avionics Software

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Abstract

Developing reusable software for avionics systems is a challenge to software engineers. The task involves foreseeing the future applications, modeling real-world events, using appropriate CASE tools throughout the development life cycle, and providing for storage and retrieval of reusable software components. This report presents a model for developing and managing reusable software components, briefly describes the software process maturity model and the integration of CASE tools with the process maturity model. It also identifies tools/ techniques and methodologies for real-time systems development, examines the critical issues in managing software projects, and offers the management a set of guidelines to introduce software engineering methodologies and CASE tools within the organization through a model project which may enforce standards for new projects.

USING A NEGOTIATION SUPPORT SYSTEM TO INTEGRATE INTERESTS

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Abstract

The current study used a variable-sum negotiation task to determine the degree to which computer-assisted dyads are better than manually assisted and unassisted dyads at achieving integrative bargaining agreements. Male and female dyads engaged in both a four-issue and an eight-issue negotiation during a single experimental session. While computer assistance did not improve performance for females, computer assisted males obtained a significantly higher proportion of the integrative total on the four-issue task than did unassisted and manually assisted males. In addition, while computer assistance did not appear to improve interest estimation, significant positive correlations were obtained between estimation accuracy and the outcome measure for both tasks.

NUMERICAL MODELING OF GROUNDWATER FLOW AND TRANSPORT AT THE MADE-2 SITE

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Abstract

Public domain computer programs were used to model the tritium plume observed during Macrodispersion Experiment 2 (MADE-2), a field scale natural gradient experiment conducted at Columbus Air Force Base, Mississippi. The finite difference program MODFLOW was used to simulate the flow of groundwater through a 330 m x 105 m computational domain. The grid had 66 rows, 21 columns, and 9 layers - a total of 12,474 cells. The 468 day experiment was simulated on a Sun Sparcstation 2 in 37 minutes, assuming uniform hydraulic conductivity, and in less than 6 hours with a more realistic, highly heterogeneous conductivity field derived from 67 measured conductivity profiles. Both solutions had small mass balance errors and appeared reasonable, but there was insufficient time to perform satisfactory calibrations.

The mixed Lagrangian-Eulerian finite difference program MT3D was employed to solve the contaminant transport equation using the MODFLOW-predicted flow field. Dispersivities in the longitudinal, transverse horizontal, and transverse vertical directions were assumed based on a previous analysis of the MADE-2 data. Computation times were excessive: to simulate 80 days required 6.4 hours for the uniform conductivity model and 17 hours for the heterogeneous conductivity model. In both solutions there were a few cells with negative concentrations, and the mass balances varied erratically. Both models reproduced the general features of the observed plume on simulation day 42, but the heterogeneous conductivity plume was definitely more realistic. Both models exhibited excessive upstream dispersion.

Further work is needed to establish a properly calibrated model for the MADE-2 experiment, and to develop practical modeling tools for the generic plume prediction problem.

Anti-Penetration Laboratory Data Acquisition and Control Systems

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Abstract

Over the past several years there have been a growing number of manufactures developing PC data acquisition and control systems. The Anti-Penetration Laboratory at Tyndall AFB, Florida acquired several examples of the PC data acquisition and control systems for experimental use and evaluation. It was discovered that ease of operation of the various data acquisition systems varied, some were straight forward, and some take a great deal of familiarization to operate effectively. However in all the cases the users of any of the several data acquisition systems must extensively familiarize themselves with each particular data acquisition system to be used then frequently refresh their memories to remain familiar with the data acquisition system. Any break in the use of a particular data acquisition system usually requires retraining. The retraining is time consuming, but lack of continued familiarity with the system will lead to data error or lost data. The PC data acquisition systems are designed to fill several niches. The faster PC data acquisition systems currently operate around 40 MHz, will measure voltages or currents and store data for later evaluation, maximum data storage before a break is usually limited to the size of the RAM on the data acquisition board. Available RAM on a data acqusition system is up to 8-megabytes and growing.

A STUDY OF VIRTUAL REALITY AND ITS APPLICATION TO AVIONICS

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Abstract

A literature search on the topic of virtual reality was performed. Books, magazine articles and conference reports on the topic were read and relevant ones saved. A flicker free 3-D television system using standard television equipment with no hardware modification, which was built last summer, was updated with new circuitry developed during the school year to provide color pictures with reduced artifacts. A 486 computer system was programmed and interface circuitry built to provide both static and moving three dimensional pictures on the computer display. This system also used the flicker free methods developed last summer. New techniques for stereoscopic glasses, head mounted displays, and three dimensional displays were investigated.

Real-Time In Situ Ellipsometry of Polymer Films Produced by Flowing Afterglow Synthesis

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Abstract

A helium-neon laser-based ellipsometer has been constructed and coupled to a flowing afterglow plasma reactor to monitor in real time the growth of polymeric thin films formed from benzene and thiophene precursors. This phase modulated ellipsometer is shown to be robust and to provide time-dependent data that vary sensitively with film thickness. Progress has also been made in evaluating the utility of benzene/thiophene precursor injection using a pulsed injection valve downstream of the argon metastable excitation source. This system shows promise for development into an apparatus for controlled deposition of multilayer polymer films of known morphology.

TEMPERATURE-DEPENDENCE OF THE INTERSUBBAND ENERGIES AND OPTICAL ABSORPTION SPECTRUM OF MODULATION-DOPED QUANTUM WELLS

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Abstract

Infrared absorption experiments on Si-doped GaAs/AlGaAs multiple quantum wells have shown that the peak positions of the intersubband transitions are not just associated with the spacing between the conduction subbands, which only include the Hartree interaction. Numerical calculations of the quasiparticle energies show that the depolarization and exchange interactions are large and have the effect of making the transition energy between the two lowest conduction subbands decrease as the temperature increases, for a fixed electron density. This feature is quite similar to the shift in the infrared absorption peak position (a "blueshift" as the temperature is decreased). Our calculations also reveal a striking non-monatonic dependence of the blueshift of the intersubband transition energies due to the the exchange interaction as a function of the dopant density. So far, experiments have not been performed on a sufficiently large number of samples for our calculations to be compared in detail with experiment. However, the limited experimental data available seem to indicate that there is a nonlinear variation of the blueshift of the peak position of the absorption spectrum as a function of density.

SKIN-FRICTION AND FLOW DIRECTION MEASUREMENTS BY SURFACE-OBSTACLE INSTRUMENTS

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Abstract

Calibration data of surface-obstacle skin friction meters, including blocks, fences, Preston tubes and Stanton tubes, were examined throughout the available ranges of dimensionless wall-shear-stress and pressure-differential parameters. The calibration relationships, including the effect of compressibility, were reformulated in terms of variables containing physical quantities at the wall and including the probe size in only one parameter. In view of the current trend toward miniaturization, special attention was given to the range where the flow disturbance introduced by the probe remains essentially within the linear part of the velocity profile. Design criteria were derived for differential for given flow properties and shear stress at the wall. Detail design of a specific adjustable/retractable surface-obstacle device for the Wright Laboratory M3 and M6 supersonic wind tunnels was initiated, and a test program was proposed.

NONLINEAR FEEDBACK CONTROL OF LINEAR DYNAMIC SYSTEMS

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ABSTRACT

The control of various systems it is desirable to have two types of feedback control for a system depending on the distance that the system has to travel through the state space. Using a nonlinear feedback law allows for the changing of the feedback gain as a function of the system's error. The technique is primarily directed at a third order system. This limitation was primarily for the reduction of the complexity of the calculations. The feedback gain is calculated by standard linear control techniques for large and small error values. These two gain matrices are combined in a nonlinear function. For zero error, the nonlinear feedback function is equal to the small error feedback matix. For large, approaching infinity, error values the nonlinear feedback function approaches the gain matrix for large errors. One possible nonlinear function is formulated. The requirements for the stability of the system as a function of these two gain endpoints are formulated using Lyapunov's Second Method. These techniques are applied to an F-15 aircraft. This example system is a longitudinal controller based on the Short Period Approximation and a first order servo model. The nonlinear feedback function blended two LQR feedback control law designs. The results are not as dramatic as anticipated, but indicated that further study is warranted.

LOCALLY DERIVED STUDENT MODELS CAN PREDICT PERFORMANCE IN COMPUTER-BASED DRILLS

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Abstract

The construction of student processing models was tested. Response certitude judgments, latencies, and response correctness histories were recorded from each of 48 subjects in about 4 hours of interactive computer drills. Results indicate that these easily collected data, along with various instructional manipulations serve as statistically significant predictors of performance, both for the grouped data and on a subject by subject basis. In the future such models could be fit for each trainee and enable more robust administration of instruction in Intelligent Tutoring Systems and other forms of computer managed learning.

THE COGNITIVE IMPLICATIONS OF COMPUTER-BASED LEARNING ENVIRONMENTS: A CONCEPTUAL FRAMEWORK

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ABSTRACT

Interest has emerged in the design of alternative learning systems, characterized collectively as "learning environments." Learning environments are comprehensive, integrated systems that promote cognitive engagement through learner-centered activities, concrete manipulation, and guided exploration. In this paper, a conceptual framework for learning environment research and development is presented. The purposes of this paper are to briefly summarize research and theory related to learning environments, identify similarities and differences between learning environments and conventional training and instruction, describe the underlying foundations and assumptions of learning environments, and describe the cognitive consequences of such systems.

A MOLECULAR DYNAMICS SIMULATION OF ELECTROMIGRATION

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Abstract

A flexible model of polycrystalline metallization on integrated circuits was developed, and the construction of a computer simulation to study electromigration in such structures has begun. This work was part of an ongoing effort to determine whether microcircuit failure due to electromigration can be reduced or eliminated. Experiments have revealed that void formations in aluminum interconnections on integrated circuits result from current-induced transport of metal atoms [1]. A computer model is being developed to simulate this effect. The model will permit variation of boundary conditions, including grain size and orientation, thermal effects, crystallite composition, as well as interatomic potentials. The roles of grain boundaries and interstitial atoms are of particular interest since these are parameters that can be controlled, to some degree, during fabrication. The computer code is not complete; specific results are not reported. However, progress was made in the development of the model, and significant portions of the code have been written. A commitment to completion endures regardless of further support.

A FAST ATM ROUTING ALGORITHM FOR THE DYNAMIC THEATER ENVIRONMENT

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Professor

and

Claud K. Jones

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ABSTRACT

Traditional tactical and theater military communication networks are characterized by relatively low bandwidth links. The environment is dynamic in the sense that the links are subject to jamming and the nodes to destruction by the enemy. Modern and future military equipment and tactics require the use of wideband links to exchange bandwidth-intensive information such as video and images. However, current and proposed wideband networks such as ATM have been designed for peacetime, i.e. well-behaved operation. The research described herein proposes and develops an original Fast ATM Routing (FAR) protocol which adapts wideband ATM networks for operation in the dynamic theater environment. It is shown that the FAR protocol provides robust performance in such an environment.

A Framework of Multiresolutional Target Tracking

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Abstract

A framework of multiresolutional target tracking has been established. The wavelet transform is employed in constructing multiresolutional data and model structures. Multiresolutional tracking is performed over the multiresolutional data and model structures in a top-down fashion. The main advantages of multiresolutional target tracking include: computational efficiency, performance robustness and algorithm flexibility. Two-level joint probabilistic data association (JPDA) – nearest neighborhood (NN) and NN–JPDA target tracking algorithms are developed. Computational efficiency is achieved and advantages of both JPDA and NN are combined.

Estimating The Number Of Defects Under Imperfect Environmental Stress Screen Levels

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Abstract

A fixed sample size procedure is proposed to quantify the initial and refined estimates of the defect of electronics density for Environmental Stress Screening (ESS) plans. The idea of group testing, i.e., testing units in batches instead of individually, where each test indicates whether the test batch contains only good parts or whether it contains at least one defective, is applied to the problem of estimating the probability, π, of an arbitrary unit being defective. Five estimators are given with their root mean square error, or asymptotic variance. An example and table of procedure parameters are given to illustrate the proposed method.

EFFICIENT COORDINATION OF
AN ANTHROPOMORPHIC TELEMANIPULATION SYSTEM

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Abstract

This report documents the development of coordination algorithms for control implementation of an anthropomorphic telemanipulation system presently at Wright-Patterson Air Force Base. The telemanipulation system, which is to be used as a research platform in facilitating studies on human sensory feedback, comprises a 7 d.o.f, force-reflecting, exoskeleton master and a 6 d.o.f. articulated slave robot. The approach taken in the development emphasizes on the practical issue of computation efficiency -- a primary concern for satisfactory real-time operations. The algorithms presented here have been fully tested and implemented on the system. Implementation results indicate at least a five-fold improvement on the control sampling rate has been achieved (from 11 Hz to 62 Hz on a 68020-based VME board). Other practical issues of implementation are also discussed in this report.

OPTICAL AND ATMOSPHERIC TURBULENCE

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Abstract

For many important applications it is imperative to estimate correctly the spectral density of atmospheric turbulence. To this end one must collect meteorological data and "detrend" it to obtain the turbulent residual. The objective of this project was to experiment with different detrending (= filtering) strategies and gauge their impact on the computed spectral densities of the flow variables. To help accomplish this objective a general purpose software package was written and used.

EVALUATION OF NETWORK TOPOLOGY IN A DISTRIBUTED PROCESSING ENVIRONMENT

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Abstract

The impact of network topology on the performance of a distributed processing environment was evaluated through experimentation and simulation. Experimental runs of the JDL experiment on Cronus were used to collect traffic data for use in determining the limitations of Ethernet-based networks. Discrete-event simulation and analytical modeling were used to estimate the performance of heavily-loaded Ethernet and FDDI networks.

MOLECULAR DYNAMICS SIMULATION OF B2 Ni-Al

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Abstract

The development of alloys based on the ordered intermetallic alloy NiAl in the are of interest for high temperature aerospace components. NiAl in the B2 structure is also a popular material for basic scientific research in ordered alloys. In this regard, there has been recent interest in understanding dislocation mobility in NiAl at the atomic level through atomistic computer simulation. Atomistic simulations employing realistic elastic boundary conditions of straight dislocations have been used to estimate relative dislocation mobilities by determining the stress required to initiate dislocation motion. However, these studies have been confined to zero temperature. Many properties, such as the thermal activation of kink pairs and the activation pathway for dislocation cross slip, are best studied using finite-temperature molecular dynamics simulations.

In order to test and develop molecular dynamics simulation capabilities for dislocation-mobility studies, as well as to begin maintaining a database of thermal properties of the NiAl potential, preliminary molecular dynamics studies have been carried out to study stoichiometric NiAl in the B2 structure at 400°K using an empirical embedded-atom-method potential developed explicitly for NiAl. Computer codes have been developed and tested to statistically process data generated in the course of the simulations. Such thermodynamic quantities as the energy, heat capacity, temperature, stress tensor, volume and pair distribution functions can be calculated in various thermodynamic ensembles. In preparation for the simulation of dislocations and dislocation mobility, a capability has been developed to track the mis-coordination of atoms and their average spatial coordinate through the course of the simulation.

SPRAY MEASUREMENTS USING MICROWAVE BEAM

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ABSTRACT

The use of a microwave beam for spray diagnostics has been investigated. Microwave attenuation through the spray was estimated. It was found that microwave and spray interaction can be modeled using Rayleigh theory, and microwave can penetrate optically thick sprays. Also, microwave transmission efficiency is strongly dependent on the selected wavelength. Based on these microwave properties, it was concluded that non-intrusive probes based on microwave beams (frequency higher than 10 GHz) may offer new diagnostic capabilities for optically thick sprays. A probe to measure spray patternation based on the microwave absorption can be designed.

ANALYTICAL METHODS FOR THE DETERMINATION OF WEAR METALS IN PERFLUOROPOLYALKYLETHER LUBRICATING OILS

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Abstract

Analytical methods for the determination of wear metals in perfluoropolyalkylether lubricants have been developed. Inductively coupled plasma atomic emission spectroscopy (ICP-AES) has been chosen as the analytical technique due to its sensitivity and lack of serious interferences. The method developed allows for the rapid determination of 20 metals along with phosphorus and sulfur. Analytical standards have been prepared using metal complexes of the ß diketone 2,2-dimethyl-6,6,7,7,8,8,8-heptafluoro-3,5-octanedione. These complexes were prepared and characterized prior to use. The PFPAE lubricants studied include Krytox 143ac and Fomblin Z. Detection limits for the various metals have been determined to be in the range of 10-100 parts per billion for the various wear metals. Detection limits for phosphorus and sulfur are 10 parts per million.

A FEASIBILITY STUDY OF A 70-K PERIODIC SORPTION CRYOCOOLER AND THERMAL MANAGEMENT OF SODIUM SULFUR BATTERY MODULE

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Abstract

This report contains the results of investigations conducted on two separate projects. The first is a thermodynamic feasibility study of a periodic sorption cryocooler, operating between a heat source at 70 K and a heat sink at 273 K. The second embodies an analysis for thermal management of a sodium-sulfur (Na-S) battery module for a GEO flight experiment. The performance objective of the cryocooler is to provide 0.5 W of cooling using a maximum thermal power of 30 W. A three-stage cascade electrochemical-sorption refrigeration cycle which consists of a heat source stage powered by an oxygen electrochemical compressor, a heat sink stage employing two sorption compressor beds, and an intermediate stage connecting the two stages is considered for thermal performance analysis. The intermediate stage, which operates intermittently, utilizes a phase change material (PCM) to facilitate energy storage for the heat dissipation of the heat source stage and uses a single sorption compressor bed powered by an external electrical heater and cooled by evaporation of the working fluid in the heat sink stage of the cryocooler. A data base containing the freezing temperature, in the range of 2-300 K, of over 500 chemical elements and compounds was created to assist in the selection of suitable working fluids and PCM for the cryocooler. It is shown that, through proper selection of working fluids, the objectives of the cryocooler are attainable by a two-stage cascade cycle. Further investigations on the vapor adsorption capacity of solid sorbents, the physical properties of gas-sorbent pair, and the sorption compressor beds' energy regeneration concepts are recommended. The thermal behavior of a Na-S battery module containing eight cells and covered with multi-layer insulation (MLI) is analyzed. Consideration is given to storage of energy in the battery during the discharge period and use of the stored energy during the charge period to maintain the batteries within the operational temperature range of 325 to 375 °C. The temperature-time history during a charge-discharge cycle indicated that without the battery, cells cannot store sufficient energy during discharge to maintain the batteries within the specified temperature range. Use of additional energy storage material is recommended to avoid requiring heaters during the charge period. The use of phase change material (PCM) for energy storage is also highly recommended.

SPIN EVOLUTION OF THE LAGEOS SATELLITE

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Abstract

LAGEOS (**LA**ser–ranged **GEO**dynamic Satellite) is a dense spherical satellite covered with a total of 426 corner-cube LASER retroreflectors, which allow its tracking to extremely high accuracy. Such accuracy yields a medium term (years to decades) inertial reference frame, which may be determined via relatively inexpensive observations and which can be used as an adjunct to more difficult and more data intensive absolute frame measurements via VLBI (Very Long Baseline Interferometry). LAGEOS will lead to significantly better position determination and timing accuracy. It will allow bench marking of a global-positioning system against a surface-based coordinate system. There is a substantial secular precession of the satellite line of nodes consistent with the classical, Newtonian precession from the non spherical Earth. There has been a suggestion (Ciufolini) of launching an additional satellite (LAGEOS–3) that would experience equal and opposite classical precession than LAGEOS–1. LAGEOS–3, besides providing a more accurate real–time measurement of the rotation rate of the earth and its orientation parameters, it will provide the first direct measurement of the magnetic component of gravity (*the gravitomagnetic or frame–dragging force*) predicted by Einstein's 1915 and still standard theory of gravitation. Of the five dominant error sources in this experiment, the largest one (potentially) involves surface forces on the satellite and its consequent impact on the orbital nodal precession. The surface forces are a function of the orientation and spin rate of the satellite. Consequently, we have undertaken a theoretical and experimental effort to model the spin dynamics of the LAGEOS satellite. We present in this report our preliminary results.

WHITE-NOISE ANALYSIS OF CAROTID BARORECEPTOR FUNCTION IN BABOONS

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Abstract

A white-noise protocol was evaluated for characterizing carotid baroreceptor function in three adult male baboons. The white-noise (pseudo-random binary) stimulus was created by varying the pressure in the right carotid sinus. The pseudo-random stimulus was sustained for a period of 3 minutes at 3 different mean levels-- 40 mm Hg, 70 mm Hg and 100 mm Hg. The baroreceptor response at each mean level was indicated by continuously measuring the pressure in both the right atrium and the aorta. First-order Wiener Kernels were calculated from this stimulus-response data (see Appendix A for analytical details). The first-order Wiener Kernels were then used to predict the pressure changes in the right atrium and aorta which would result from a pulse of pressure at the right carotid sinus.

The white-noise protocol reveals that the carotid baroreceptors are still effecting right atrium pressure more than 50 seconds after the pressure in the right carotid has been pulse modulated. If our predicted responses are correct, then the time-constants for g-induced cardiovascular changes can be much longer than expected. Also, the delayed response is in the wrong direction-- a positive pulse at the carotid sinus causes vasoconstriction.

These unexpected results could be the result of reduced pO2 at the right carotid sinus, which is a common situation in prolonged air combat. Other investigators have reported that the carotid baroreceptor response is entirely eliminated under similar conditions. In future experiments, we will investigate the effect of pO2 on carotid baroreceptor transduction speed. We will also use aperiodic pulse stimuli, i.e. random intervals between the pulses, and will continue to measure the response to each pulse stimulus for 100 seconds after each stimulus.

An Exploratory Study of Weighted Fuzzy Keyword Retrieval for the CASHE:PVS System

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Abstract

The purpose of this project was to explore the possibilities of providing improved retrieval capabilities to the CASHE:PVS system. That system currently provides access to human engineering studies and allows users to navigate from one entry to another and to simulate ergonomic experiments in order to provide understanding and improved design. The use of keywords, weights, and fuzzy Boolean logic have been explored in order to determine the feasibility of this approach, based in large part on the series of sample queries constructed for CASHE:PVS and known as the Design Checklist. Future steps necessary to continue to demonstrate the feasibility of this approach and to integrate this approach into the CASHE:PVS system are presented.

ADAPTIVE ALGORITHMS FOR ANTENNA ARRAY SIGNAL PROCESSING

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Abstract

Quantized-state adaptive algorithms are proposed for adaptive multibeam antenna signal processing and are compared to the known sample matrix inversion and the correlation feedback algorithms of the adaptive antenna signal processing literature in terms of various performance measures of interest. Such performance measures include the interference rejection capability, the computational requirements, convergence rate, numerical robustness for implementation with finite precision arithmetic and fraction of the area coverage lost due to nulling of interference sources. Simulation results show that the quantized state algorithms proposed earlier by the author for somewhat different signal processing problem of adaptive equalization, along with some very significant modifications such as inclusion of an appropriate deadzone in the quantization process, multiple thresholds and a novel method of step size selection etc., constitute powerful algorithms for the multibeam antenna signal processing problems. The proposed schemes are shown to be superior to other known techniques in terms of most of the performance criteria.

PROCESSING ASPECTS OF GLASS MATRIX, FIBER AND CERAMIC COMPOSITES FOR ELECTRONIC PACKAGING

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Abstract

Glasses and glass-ceramics are well known for their low dielectric constants ($\varepsilon \approx 3\text{-}5$) at 1MHz which makes them useful candidate materials as substrates for high speed electronic packaging. On the other hand crystalline ceramics have moderate dielectric constants ($\varepsilon \approx 9\text{-}12$) at 1MHz while non-oxide ceramics such as AlN and SiC have excellent thermal conductivity values useful for high power packages. Glass matrix, fiber and glass infiltrated ceramic composites with interconnected phases therefore, have the potential of displaying optimum thermal and electric characteristics which could make them useful as substrates for electronic packaging. Borosilicate-Nicalon fiber-glass composites were fabricated using pressure and pressureless sintering techniques. At the same time preliminary experiments were conducted to fabricate composites using SCS fiber and borosilicate glass incorporating tape casting approaches. Preliminary experiments were also conducted to process porous aluminum nitride ceramics hot infiltrated with borosilicate glass. Results of optical characterization of the composites indicate that infiltration of Nicalon cloth with glass is achieved by hot pressing at 1000°C using a pressure of 1000 psi, while the tape casting and lamination approach followed by sintering is useful for fabricating Nicalon tows and glass composites. On the other hand aluminum nitride ceramics were fabricated with ≈ 28% interconnected pores. Hot infiltration yielded ≈ 100 μm penetration of glass into the pores of the nitride ceramic. The paper discusses the processing aspects of these composites.

Generation of ELF and VLF Waves in the HF Heater-Modulated Polar Electrojet by Two Heater-Modulation Schemes

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Abstract

Generation of ELF/VLF waves in the HF heater-modulated polar electrojet is studied. The electron temperature of the electrojet is modulated by an amplitude modulated HF heater. It in turn causes the modulation of the conductivity and, thus, the current of the electrojet. Emissions are then produced at the modulation frequency and its harmonics. Two heater-modulation schemes are considered. On, modulates the heater by a periodic rectangular pulse. The other one uses two intersecting heaters (beat wave) having a frequency difference equal to the desired modulation frequency. The nonlinear evolutions of the generated ELF/VLF waves are determined numerically. Their spectra are also evaluated. The results show that the signal quality of the second (beat wave) scheme is better. The field intensity of the emission at the fundamental modulation frequency is found to increase with the modulation frequency, consistent with the Tromso observations.

Investigation of deep levels in MBE grown $Hg_{1-x}Cd_xTe$ using DLTS experiments

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Abstract

Deep levels in MBE grown $Hg_{1-x}Cd_xTe$ were investigated for the first time using DLTS experiments. The experiments included a state-of-the-art data acquisition system which provided better control over a wide range of temperature values. Also, the experimental setup is made to include the CCDLTS option which is known to complement the basic DLTS experiments for further investigation of major properties of the sample. After an initial calibration of the experimental setup with an AlGaAs sample, experiments performed on $Hg_{.724}Cd_{.276}Te$ samples indicate the existence of traps at four levels. However, the interpretation of the experimental results was far from exhaustive.

Due to the narrow gap of the $Hg_{1-x}Cd_xTe$, it is generally recommended to modify the DLTS/CCDLTS experiments so as to account for voltage dependent effects (i.e. appearance of shoulder on the DLTS scan and Poole-Frenkel effect). These effects are not investigated in this study but the "shoulder" predicted in DLTS scans in narrow gap materials can be identified on the DLTS scans.

RESEARCH IN EMERGING TECHNOLOGIES AT PHILLIPS LABORATORY

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Abstract

Progress is reported in theoretical and computational studies related to the research interests of the Emerging Technology Branch at Phillips Laboratory, Edwards AFB. Topical areas under investigation include (i) alkali metal vapor spectroscopy & solar rocket propulsion (ii) Al_2 & AlLi vapor and high-energy density materials (iii) high energy density materials evaluation, (iv) spectra of trapped atomic radicals, (v) instrumentation for the Larson/Edwards plasma spectroscopy cell, (vi) an ARPA/Edwards solar receiver project, and (vii) aspects of cavity QED experiments. In each case progress is reported, the current status of the research effort is provided, and work in progress or continuing is indicated.

MODULATION AND CELLULAR RESPONSES TO NITRIC OXIDE

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Abstract

The free radical Nitric Oxide has profound effects on cells, tissues and organs. This research was undertaken to elucidate the pathways and mechanisms involved in some of the Nitric Oxide effects. We used flow cytometry extensively in our research. We sought to verify a number of well-defined premises. The research led to numerous questions and problems that need to be investigated. It also revealed several potentially important leads that would be helpful clinically and in other disciplines.

INCIDENCE RATE ESTIMATE OF ELEVATED PEDIATRIC BLOOD LEAD AT TWO AIR FORCE BASES

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Abstract

To account for possible large analytic errors in blood lead measurements, a bivariate lognormal model was employed to predict blood lead values of those children whose initial measurements were 10 micrograms per deciliter (μg/dl) or higher. Reductions of seventy and twenty-five per cent in the number of children with elevated blood lead levels at two Air Force Bases (AFBs) were shown by the use of the model. Assuming the mean and standard deviation of the true blood lead of the child population at two Air Force Bases are 7 μg/dl and 6.5 μg/dl, respectively, the overall incidence rate for both Air Force Bases was about the same at 0.8 percent. However, if the incidence rate is estimated by the place of residence, the incidence rates at the two Air Force Bases are very different. The off-base rate at Offutt AFB is six times the rate found at Randolph AFB; whereas, the on-base rate at Randolph AFB is three and one half times the rate found at Offutt AFB. In addition, the percentages of false negatives and false positives are calculated. Because of a larger analytic error in the blood lead measurements at Randolph AFB, the percentages of false negatives and false positives (which are higher than that at Offutt AFB) are eleven and fourteen percent. Suggestions for further study are also made.

Min-Chang Lee's report not available at time of publication.

Hydrothermal Effects on the Structural Integrity of Graphite Fiber-Cyanate Ester Resin Composites

by

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Abstract

The weight change and the retention of in-plane shear (+/-45°) strength of graphite fiber-reinforced cyanate ester resin matrix composites have been measured on the exposure to *high humidity* and *thermal cycling* respectively. Cyanate ester resin matrix composites absorbed a remarkably small amount of moisture on the exposure to 95% RH condition at 60°C up to 36 days. However, the degree of moisture absorption underwent a rather sudden increase to an equilibrium level of 1% after the prolonged exposure. The morphology study showed the occurrence of extensive cracking of matrix/interface region in the form of the delamination between the plies as well as translaminar cracking within the ply. The phenomenon is believed to be caused by weakening of the fiber-matrix *interface* which was confirmed by microscopy analysis of fracture surface. A sudden moisture gain associated with extensive matrix/interface cracking was found to reduce in-plane shear strength and fatigue lifetime at a given stress amplitude. From the assumed relationship between the slope of S-N curve and 'm' factor of Paris law, it was hypothesized that the rate of crack growth is higher for wet specimens already with extensive cracks initiated. The rate of in-plane shear strength degradation was also measured on the static exposure to dry heat as well as thermal cycling to a peak temperature of 150 or 204°C. At a frequency of 10 min/cycle and for a relatively short duration, the effect of thermal cycling seems to be represented by the cumulative sum of thermal degradation effect at the peak temperature.

Characterization of Pure and Doped $Bi_{12}SiO_{20}$

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Alfred University

Abstract

This reports describes research performed at Rome Laboratories, Hanscom AFB, MA under a summer research program. Two separate areas of research were investigated. The first concerned defect studies of pure and doped $Bi_{12}SiO_{20}$ (BSO) grown at Rome, and the characterization of this material by way of photoconductivity and optical absorption measurements. This is part of an ongoing effort to understand the photorefractive properties of BSO, particularly the photorefractive response at longer (larger than 500nm) wavelengths and how to enhance this response. Photoconductivity measurements were made on undoped BSO grown by Czochralski (Cz) and Hydrothermal transported material, as well as material doped with various impurities. Undoped Cz BSO exhibited excellent photoconductive response under a wide spectral range. A peak was observed in the photoconductivity spectrum, identifying a resonance absorption at 510nm. Hydrothermal material, however, exhibited only minor photoconductive response only at a wavelength corresponding to the bandgap energy of BSO. BSO samples doped with transition metals were observed to lose the majority of their photoconductive response as the impurity apparently kills photoconductivity. An attempt was made to change the charge state of transition metals by irradiation in an effort to revive the photoconductivity. Various degrees of success in enhancing photoconductivity in the red region of the spectrum was met by doping with Al and B, and co-doping these samples with V and Mn. Vastly different photoconductivity results were obtained between Cz and Hydrothermal material doped with the same impurity. Various photoconductive quenching was observed in many of the samples, particularly in the doped hydrothermal material. $Bi_{12}TiO_{20}$ (BTO) material transported by the hydrothermal technique was observed to have excellent photoconductive response, unlike hydrothermal BSO. The second area of research investigated at Rome under this program involved the study of optical waveguides in BSO. The refractive index of BSO grown by various techniques was measured, and the fabrication of waveguides using ion implantation and liquid phase epitaxy was investigated.

CONDUCTED INTERFERENCE SIMULATION RESULTS FOR A GENERAL ELECTRIC SOFT PART ANALOGOUS MODULE (SPAM)

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Abstract

The Soft Part Analogous Module (SPAM) [1] is a high speed 1-megabit RAM that was built by the General Electric (GE) Corporation to verify multi-chip-module (MCM) fabrication techniques and processes prior to full construction of radiation hardened MCM's. Conducted Electromagnetic Interference (EMI) measurements were performed on this MCM as well as on the individual integrated circuits (IC's) within the MCM [2]. The individual IC's were measured in order to determine if simpler and less expensive IC's could be evaluated prior to testing a more complex and costly MCM. Conducted EMI simulations for two of the MCM interface IC's are presented in this report. SPICE circuit analysis was used to simulate conducted EMI. The utilization of Harmonic Balance circuit analysis to simulate conducted EMI is discussed in the Appendix.

TARGET DETECTION WITH SYNTHETIC APERTURE RADAR AND COHERENT SUBTRACTION

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Abstract

This report considers target detection with synthetic aperture radar and coherent subtraction. We shall show with experimental data that the coherent subtraction technique may be used to surpress Gaussian outliers and obtain approximate Gaussian distributions for clutter and noise. We shall also derive generalized likelihood ratio (GLR) detection algorithms that may be used with SAR images that are obtained with coherent subtraction. We shall analytically compare the performance of a) a single pixel detector, b) a detector using a complete knowledge of the target signature information and known orientation information, c) a detector using an incomplete knowledge of the target signature information and known orientation information, d) a detector using unknown target signature information and known orientation information, and e) a detector using unknown target signature information and unknown orientation information.

THE EFFECT OF CALCIUM CHANNEL BLOCKERS AND NEUROPEPTIDE Y ON VASCULAR SMOOTH MUSCLE CELL PROLIFERATION IN CULTURE

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Abstract

As an index of cell proliferation, incorporation of ^{3}H-thymidine, into pig coronary artery rings cultured without serum and into embryonic rat vascular smooth muscle cells (A-10) cultured in medium with 2% fetal calf serum, was determined during exposure for 48 hours to the calcium channel blocking agents verapamil, diltiazem and nifedipine and during exposure to porcine neuropeptide Y (NPY). Uptake after exposure to each of the channel blockers plus NPY was also studied. Results were different in the rings as compared to the studies of pure smooth muscle cells although, because of the small sample size, only a few of results of the study of the pig artery rings were statistically significant. The channel blockers alone in doses near 10^{-4} M and probably at 10^{-5} M diminished ^{3}H-thymidine uptake in the rings but clearly produced significant inhibition in the cells in pure culture. Although NPY had no measureable effect on the coronary rings it was significantly mitogenic when used in the pure cell culture studies. The combination of channel blockers with NPY did not totally eliminate the stimulating effect of NPY on cell proliferation although verapamil was most potent in this regard. We conclude that NPY is a mitogen whose cell proliferative effects are not totally mediated by the entry of calcium ion into the cells. Taken all together the results support the hypothesis that calcium for mitogenesis may be derived from both intracellular and extracellular sources. Further we speculate that the calcium channel blockers used in treating patients may not inhibit all of the coronary artery intimal smooth muscle proliferation in stressed patients who have increased NPY secretion but that verapamil, and to a lesser extent, nifedipine and diltiazem in that order of potency may diminish this undesireable effect. Additional studies are required to prove this hypothesis.

STRUCTURAL DAMAGE DETECTION OF A PLANAR TRUSS STRUCTURE USING A CONSTRAINED EIGENSTRUCTURE ASSIGNMENT

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Abstract

System health monitoring of aerospace vehicles is important not only to conducting safe operation but also to maintaining system performance. Structural health along with sensor and actuator malfunction must be monitored to perform the system health monitoring. As a step toward developing a system health monitoring scheme, this research investigates structural damage detection using a constrained eigenstructure assignment. The eigenstructure assignment is selected for the investigation since it may be used not only to perform structural damage detection but also to monitor the sensor and actuator performance in a unified manner. To employ the eigenstructure assignment in the framework of structural modeling and modal testing, a concept of constrained eigenstructure assignment is developed. The constrained eigenstructure assignment makes it possible that the computed feedback gains correspond directly to the structural parameter changes. To demonstrate the capability of the approach, a twenty-bay planar truss structure is employed. Modal tests are performed using eleven accelerometers for the undamaged structure and several missing member damage cases. Then the test data are used to locate the missing member. In spite of the incomplete mode shapes and test inaccuracies, accurate damage detection is conducted.

OPTICAL TECHNIQUE FOR MEASURING TIRE DEFORMATION AND STRAINS

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Abstract

The main objective of this research was to investigate the feasibility of applying an optical technique called fringe projection to quantifying aircraft tire deformation and strains. Three different types of tires in static and dynamic conditions, subjected to different amount of tire deflections, were tested. The experimental results indicate that the proposed measuring system and the optical technique were capable of measuring tire deformation and strains. Some results of data analyses are included in this report. It was found that the key to more accurate three dimensional geometry determination is to keep track of the geometric change of the reference point on a tire when subjected to loading. Finally, the conclusions for this work are made, and the future work is recommended.

AN ANALYTICAL MODEL FOR AlGaAs/GaAs MULTI-EMITTER FINGER HBT INCLUDING SELF-HEATING AND THERMAL COUPLING EFFECTS

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Abstract

An analytical model which can be used to predict the thermal as well as electronic behavior of the multiple emitter heterojunction bipolar transistor (HBT) is presented. The model is developed from the knowledge of device make-up (doping concentrations, layer thicknesses, etc.), and relevant physics such as the effects of graded heterojunction, self-heating, thermal coupling, and ballast emitter resistance are included in a unified manner. Thermal runaway, or current crush, phenomenon observed in the multi-finger HBT at high current level has been successfully described. Experimental evidences obtained from a 6-finger and 4-finger HBTs are included in support of the model. We found that the current crush phenomenon is caused by the uneven increase of the base and collector currents at elevated temperatures due to the thermal effect.

GHz MICROWAVE RADIATION BY PICOSECONDS OPTICAL PULSES

by

David Liu

ABSTRACT

High power, directional 1~20GHz microwave radiation has been generated out of high resistivity by 50 picoseconds optical pulses. The radiation signal generated as well as the associated mechanisms were monitored directly on the sampling oscilloscope in real time. The phase, amplitude, and direction of the radiation can be effectively manoeuvered by optical method. The combination of optics and microwave of this innovative technique provides the potential of flexibility, simplicity and low cost in microwave applications.

THE GLOTTAL PULSE:
POSSIBLE APPLICATIONS TO SPEAKER IDENTIFICATION

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Abstract

One of the major current thrusts of the Speech Processing Lab at Rome Labs is speaker identificiation. There is evidence that the vocal fold vibrations (the glottal pulse) may provide unique information capable of differentiating between speakers. If this is true, glottal pulse information could be used to substantially improve current speaker identification algorithms. An in-depth literature review of what is known about the glottal pulse waveform cooberates this evidence. Recommendations are made about appropriate equipment to use in future investigations of glottal pulse waveforms in speaker identification.

COMPUTATIONAL METHODOLOGY FOR WIND TUNNEL SPRAY BAR DROPLET DIPSERSION

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ABSRACT

The objective of this research was to determine a computational methodology for robust and accurate prediction of spray bar droplet dispersion for engine icing tests. This is of significance to AEDC in that a) current ice accretion testing has resulted in non-uniform spatial distributions and b) large scale icing condition testing on the ASTF Test Cell C facilities is planned within a year and requires the implementation of a large spray bar apparatus. Therefore, it is important that a suitable predictive engineering tool be developed. Specifically, the physical mechanisms of spray bar wake turbulence and droplet evaporation must be included in order to properly model the controlling mechanisms of the flowfield. This report will identify basic flow physics, review previous computational and experimental technology, review proposed code methodology, describe initial results and make appropriate recommendations. The proposed characteristics of the computational model are as follows: three-dimensional Lagrangian droplet treatment coupled with either a two-dimensional or three-dimensional air flow field with a two-equation turbulence model, neglection of droplet collision and breakup, and neglection of turbulence modulation.

VAPORIZATION AND DECOMPOSITION OF TRICRESYL PHOSPHATE(TCP)

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ABSTRACT

The boiling point of tricresyl phosphate (TCP) was estimated to be 440°C at atmospheric pressure using the Clausius-Clapeyron equation, and was observed to be between 420°C and 435°C by distilling a commercial grade TCP at atmospheric pressure. Experiments were conducted to study the rheological changes, viscosity and molecular weight by heating a commercial grade TCP in open and sealed tubes between 250°C and 480°C in both dry air and nitrogen environments. It was found that below 380°C, both the viscosity and the molecular weight increased significantly with temperature in dry air, while the changes were very minor in nitrogen. Above 450°C, the TCP solution decomposed in both air and nitrogen with decreases in molecular weight and viscosity. Between 390°C and 410°C, the molecular weight began to decrease while the viscosity continued to increase. We suggest that this is a transition region where TCP molecular chains begin to break and evaporation begins to occur.

HYDRAULIC CONDUCTIVITY VARIABILITY: CO-KRIGING

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Abstract

The spatial variability of hydraulic conductivity is studied using the grain-size data collected at a groundwater tracer test site located at Columbus Air Force Base in Mississippi. Following the initial study which involved vertical kriging and the construction segmented trend surfaces, a co-kriging analysis is carried out. It is observed that the total organic carbon content (toc) data do not have a great influence on the variability pattern of hydraulic conductivity. The sensitivity of the spatial pattern to certain corehole data is also observed.

HOLOGRAPHY OF EXPLODING SHELLS

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Abstract

A holography laboratory was set up and the capability to produce high quality transmission and reflection holograms was developed as the first phase of a project to make cylindrical holograms of exploding shells.

A STUDY OF WAVELET-GALERKIN METHODS FOR NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS USING MULTIGRID RELAXATION TECHNIQUES

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Abstract

A Wavelet-Galerkin method for numerical solutions of second order differential equations using multigrid relaxation techniques was studied. This method combines the approximation properties of scaling functions and wavelets with the finite element Galerkin methods for solutions of differential equations and with multigrid relaxation techniques. The Daubechies scaling function ${}_3\phi$ and the associated wavelet ${}_3\psi$ provided enough regularity to qualify as trial functions for the Galerkin method. The weak formulation of the linear homogeneous boundary value problem $-u'' + \sigma u = f$, $u(a) = u(b) = 0$, where $u \in C^{1,\epsilon}([a,b])$, $f \in L^2([a,b])$, and $\sigma \in \mathbf{R}$, was used as an example to test the developed method for numerical stability and convergence. It was established that a Jacobi or Gauß-Seidel relaxation method converges numerically very slowly to the approximate solution, especially in the case of small σ. This slow convergence is due to the fact that the eigenvalues in the spectrum of the stiffness matrix range from approximately $\lambda_{\min} \approx 0.6$ to $\lambda_{\max} \approx 272.$, and that the spectral radius of the Gauß-Seidel operator is too close to one.

Several methods to overcome the problem of slow convergence are given.

ELECTRODE DEVELOPMENT FOR AN AMMONIA FUEL CELL

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Abstract

Ammonia fuel cells, which oxidize ammonia to dinitrogen and water, have a number of potential advantages as power sources for vehicles. However, no electrocatalyst is known at present that will give sufficient specific power to make this application practical. As the beginning of a research program to develop such a catalyst, development of electrodes for an ammonia cell was undertaken, starting from electrode technology reported in the literature. The main results of this work are an improved technique for applying a Teflon-bound catalyst mass to the current collectors and the use of nickel powder as an inert filler that gives strength and leak-resistance to the electrode. Ammonia fuel cells constructed with these electrodes have run a small electric fan.

Pradeep Misra's report not available at time of publication.

FORM AND IMPLICATIONS OF THE NONLINEAR DEPENDENCE OF PHASE ON FREQUENCY FOR AN ACOUSTO-OPTIC BEAMFORMER

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Abstract

Accurate, low-noise, wideband phased array radar antennas depend on the use of true time delays between microwave elements. A photonic means of generating the required element-to-element phase shifts was developed by Toughlian and Zmuda for systems operating in the VHF frequency range, and extended by Monsay and Caccuitto for operation in the radar C band. The photonic beamformer is based on an acousto-optic (AO), heterodyne optical system, in which the reference beam acts as a probe of the acoustic wave in the AO cell. The time delay of the acoustic waveform "read out" by the optical probe from various locations along the length of the AO cell can then be imposed directly on the microwave elements of the radar beamformer, providing the correct phase for each element at whatever frequency drives the AO cell.

It is apparent that the benefits of this photonic system rely greatly on the ability of the probe beam to pick out just the right phase shift/time delay from the acoustic waveform in the AO cell. It was suggested in last summer's report that laser instability resulting in small changes in beam direction would have an impact on radar system performance because of this dependence. In the interim, it became clear that a potentially more basic limitation to the system performance could come from intrinsic diffraction effects due to the finite beamwidth of the probe in the AO cell. The latter effect has been studied in detail and its implications for design and performance of the photonic beamformer are discussed here.

A DESIGN FOR A SMALL, FORCE REFLECTING, TWO DEGREE OF FREEDOM JOYSTICK

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Abstract

A force reflecting, two degree of freedom joystick was developed at AAMRL, using servomotors as the torque actuators. This was a second generation joystick, which evolved from a similar, one degree of freedom joystick using a pneumatic actuator. The current design is a portable version of the first design. However, further miniaturization is desired to improve the reliability and durability of the joystick during transport. The focus of this work was to analyze the current design and make recommendations on the design of a smaller version of the same joystick. Details are given for a one half scale joystick utilizing the same mechanism, actuated by smaller servomotors, and interfaced to a microcomputer.

Professionals in Air Force Medical Bureaucracies: What Motivates Them to Manage?

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Abstract

Physicians are an integral part of Medical Treatment Facilities (MTFs) in the Air Force. Not only must they provide medical care, but some are expected to take management positions in the MTFs. Arguing from the literature on "professionals in bureaucracies," a causal model is developed to explain physicians' desire to manage, their willingness to train for management and their beliefs about incentives needed in the future to motivate physicians to seek management positions. Survey data on 1593 Air Force physicians are used to estimate the model. There is considerable support that physicians are motivated by professional goals and norms, such as seeing the total health care picture, overcoming bureaucratic obstacles and retaining clinical skills. This is consistent with the desire for power in the form of autonomy, rather than power in the form of control or dominance.

PRELIMINARY DESIGN OF A DUAL SOURCE FOR SIMULATING THE AM0 SPECTRUM

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Abstract

The use of multijunction photovoltaic cells in space applications has required sophisticated testing procedures using sources which can faithfully reproduce the AM0 solar spectrum. In the past commercial simulators using xenon lamps have been used. However they present a problem in that there are atomic lines in the near infrared spectrum of xenon, which severely hamper accurate testing in that spectral. region. This work presents some very preliminary design for a dual source using an Oriel lamp simulator and a tungsten lamp to produce the AM0 spectrum.

ARTIFICIAL NEURAL NETWORK INVESTIGATION IN AUTO SOURCE UPDATE PROGRAM

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Abstract

An investigation of artificial neural networks (ANN) in the candidate selection of auto source update (ASU) program was conducted. Among many types of ANNs the emphasis was given to the probabilistic neural network (PNN) architecture. As compared to other types of ANNs, PNN has proved to be reliable and superior in terms of speed of operation and simplicity of adaptation process. A PNN network was designed and implemented to find the best match and its confidence estimate for a given message among several possible candidates. Different experiments were conducted on a set of messages and candidates from the Defense Mapping Agency (DMA) databases to check the performance of the PNN. The results have been successful and promising. Future enhancement of the proposed PNN and other ANN methodologies in ASU program has also been presented.

GENERAL - PURPOSE ELECTROMAGNETIC MODELING OF COPLANAR WAVEGUIDE STRUCTURES IN MICROWAVE AND MILLIMETER - WAVE PACKAGES

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ABSTRACT

Coplanar transmission lines and coplanar waveguide (CPW) discontinuities have been analyzed by the finite–difference time–domain (FDTD) method. The FDTD computational mesh is truncated by imposing absorbing boundary conditions on the walls, thus simulating outgoing waves appropriate to an open structure. The residual reflection from these boundaries introduces significant error in the frequency–domain parameters derived by Fourier transformation of the time–domain voltages and currents calculated by FDTD at appropriate reference planes. In this research, we have developed a new computationally–efficient method called the geometry rearrangement technique (GRT) to cancel the dominant contribution to the residual reflection from absorbing boundaries. We have applied the GRT to compute the effective dielectric constant of coplanar lines as a function of frequency, and the computed results have been found to be in good agreement with published data, thus indicating the effectiveness of the GRT in canceling residual reflection from absorbing boundaries. We have developed a computer program to calculate the S–parameters of CPW discontinuities. As a test case, we have computed the S–parameters of a coplanar line with an air–bridge, and the results are in excellent agreement with measurements reported elsewhere. We are continuing to validate our program by investigation of other CPW discontinuities such as L–bend with air–bridges and/or dielectric overlay, open-circuited stub, etc. This research is applicable to efficient characterization of MMIC elements and discontinuities, and high–density microwave and millimeter–wave packages, which are currently being investigated in aerospace research. We conclude the report with a summary of potential aerospace–related problems which can be solved with the tools developed in this research.

A PRELIMINARY INVESTIGATION INTO THE NATURE OF THE GRADED PROPELLANT/INSULATION INTERFACE IN SOLID ROCKET MOTORS

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Abstract

Conventional solid rocket motors contain composite ablative internal insulation to protect the case and payload from potential thermal damage during firing. An adhesive material is used to bond the insulation to the propellant; this so-called bond line is considered to be a mechanically weak area in the rocket motor, and numerous failures in the firing of solid rocket motors are attributed to problems with this bond line. A new generation of solid rocket motors has been proposed, in which the bond line is replaced by a graded interface between propellant and insulation. The graded interface is achieved through the use of chemically similar thermoplastic elastomers (TPEs) as the binders in both insulation and propellant. In this concept, the propellant and insulation are co-extruded, and the graded interface is obtained by shear or diffusional mixing of the molten materials as they emerge from the extruder side by side. An added advantage of this concept is that the use of TPE binders in both propellant and insulation eliminates the need for the additional curing steps necessary when conventional materials such as urethanes are used. In this study, the graded interface was simulated by shear mixing TPE based propellant with a hybrid insulation. Two different TPE binders were evaluated in the insulations which were composed of a 50/50 blend of binder with either of two silicon-containing preceramic polymers. The TPE propellant and the hybrid insulation materials were mixed at three different P/I levels, representing three points in the postulated composition continuum comprising the graded interface. The mixtures were characterized by measurement of physical properties (peak and break stress, peak and break strain, and Young's modulus), and thermal properties, using DSC, TGA, and TMA. Results obtained indicate the viability of the concept; properties tended to vary smoothly with composition suggesting a "seamless" interface between propellant and insulation could be achieved. Examination of microtomed surfaces of the P/I blends using reflected light photomicrography indicated that uniform mixes of propellant and insulation were obtained. With PEBAX-2533 as the TPE, blends with polysilastyrene were easier to process than were blends with polycarbosilane. With polycarbosilane as the preceramic, blends with Kraton D-1132 were easier to process than were blends with PEBAX-2533. The combination Kraton D-1132/polysilastyrene should be evaluated to complete the study.

A STUDY OF THE GROWTH OF $YBa_2Cu_3O_{7-\delta}$ THIN FILMS ON $LaAlO_3$ BY PULSED-LASER DEPOSITION

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Abstract

The growth of $YBa_2Cu_3O_{7-\delta}$ thin films on $LaAlO_3$ substrates has been studied. The films were formed using the pulsed-laser deposition technique. This technique employs a high energy laser to ablate material from a target, the ablated material is deposited onto a substrate where film nucleation and growth can occur. The microstructure and superconducting properties of the films were determined as a function of film thickness. It was found that the films were close to the stoichiometric (123) composition, however there was evidence, both in terms of the the film's microstructure and properties, to suggest the formation of secondary phases. X-ray diffraction studies on similar films indicated that they consisted predominantly of grains oriented with their c axis perpendicular to the film-substrate interface. Examination of the surface topography of the films using atomic force microscopy also suggested the presence of grains oriented with the c axis in the film-substrate interface plane. Particles were detected on the surface of all the films and the frequency of these particles depended upon the position of the substrate during film growth. Films grown on substrates located on the left hand side of the sample holder had fewer surface particles than films grown on substrates mounted in the center and right hand side of the sample holder.

EXPERT SYSTEM RULE-BASE EVALUATION USING REAL-TIME PARALLEL PROCESSING

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Abstract

A large rule-based expert system having $O(10^3)$ rules, each involving $O(10^1)$ out of $O(10^5)$ possible Boolean conditions, can require a significant amount of processing time to evaluate. This time can be reduced if all rules have a single consequent and have antecedents which contain only conjunctions of the Boolean conditions or their complements. If the consequents do not insert new facts into the rule-base, then parallel processing can be used with even greater efficiency. Fast processing is necessary if real-time execution constraints are imposed, such as those associated with civilian and military aircraft cockpits during flight operations. This paper presents efficient data structures and algorithms to process that type of rule-base.

POST-PROCESSING OF CYLINDRICAL HEAD SCAN DATA

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Abstract

Full field surface data of cylindrically shaped objects, such as a human's head, can be acquired by rotating a triangulated laser and imaging system about the subject. The method of acquisition is imperfect and requires post processing of the data obtained. Some of the problems that must be addressed by post-processing include: spikes, rough surface data, irregular surfaces and missing data points. The problems require a variety of different processing tools, many of which are already used in the research community. However, the cylindrical nature of the data presents problems with implementation of these tools. This report presents recently developed software tools that are now available for editing and analyzing head scan data as well as some likely applications.

EXAMINING THE ROLE OF JUDGMENT AND DECISION MAKING IN THE EMERGING FIELD OF COGNITIVE ENGINEERING RESEARCH

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Abstract

Cognitive engineering is a term that has been applied to a new approach to studying the influence of information technology on the human-machine (i.e., computer) work system. It suggests a research focus that incorporates but also goes beyond contemporary research in human factors, computer science, and cognitive psychology. As a subfield of cognitive psychology, the study of judgment and decision processes has, over the past two decades, shown itself to be an important component of the overall study of cognitive functions. I will attempt to show in this paper that the study of decision processes should be a significant component of the new field of cognitive engineering as well. In this paper findings from a number of research areas in the field of judgment and decision making are summarized and their relevance to cognitive engineering is described. Some general proposals for additional research integrating decision making and cognitive engineering are suggested.

ELECTRIC FIELD INDUCED SECOND HARMONIC GENERATION IN GERMANIUM DOPED SILICA PLANAR WAVEGUIDES

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Abstract

Frequency doubling in germanium doped silica planar waveguides deposited on fused silica substrates is studied. It is demonstrated that an externally applied, periodic DC field can cause instantaneous frequency doubling in these waveguides. The periodicity which causes frequency doubling corresponds to the beat length between fundamental and second harmonic light propagating in the waveguide. A current has been measured from these periodic electrodes which corresponds to the generation of a periodic DC field internal to the glass when illuminated with both fundamental and second harmonic light.

Massively Parallel supercomputing for Large-Scale Electromagnetic Modeling

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Abstract

This report summarizes the research efforts of applying finite-difference time-domain (FD-TD) technique for Maxwell's equations on massively parallel supercomputer to model electromagnetic behavior of large-scale electromagnetic structure. The Air Force has real needs to model electromagnetic behavior of asserts having size larger than 10^7 grids in space. It is impossible to do so using current available modeling tool simply because of the enormous data needed in the modeling exceeds the computer storage of any supercomputer available at the time being. Based upon the serial large-scale electromagnetic FD-TD code which have been developed in the past year we have developed a primary massively parallel supercomputer version of the FD-TD code. It takes the unique advantages of recently available massively parallel supercomputer CM-5 and using a synchronous out-of-core technique. This code significantly reduces the I/O bottle net problem and speeds up the overall calculation tremendously. As a result we can simulate an object having size at 10^8 grids in space at a reasonable cost. It is 10 times bigger than the current state-of-the-art level. After some minor modification we should be able to model an object having size at 10^{9-10} grids in space. This means that modeling entire Jet Fighter model in space which is viewed as a "grant challenge", is no longer a far fetched dream at all. The technique we have developed is not limited to electromagnetic modeling, it can be applied to many other fields, such as large antenna design, ocean motion research, weather prediction, quantum field theory applications, optical switch modeling, neural network research, etc. As a by-product of this research we will also give some useful information and guidance for those who want to begin massively parallel supersomputing for their own project. Some cross over research efforts on massively parallel supercomputing can be developed to meet the interests of the Air Force.

Nonlinear Optical Properties Of The [GeO_4] Centers In Silica

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ABSTRACT

Semi-empirical PM3 calculations are performed on the Ge centers in Silica using a cluster approximation in the Hartree-Fock framework. We simulate Ge-doped Silica as a cluster consists of a GeO4 unit together with its four nearest SiO4 units. Electron trapping does distort the local symmetry of the Ge center where the GeO4 unit is not exactly tetrahedral. The calculations of the microscopic NLO properties in terms of static hyperpolarizabilities show a large, noticeable increase in β related to second-harmonic generation or Kerr effect for the Ge(1) center upon electron trapping.

DESIGN OF AN ACTIVE VIBRATION CONTROL SYSTEM FOR ISOLATION OF AN OPTICAL BENCH

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Abstract

The isolation of an optical bench mounted on an airplane using active noise cancellation was studied. The most difficult problem is the necessity for very high levels of isolation at low frequencies (0.1 Hz). At these frequencies, rapid separation of the base motion into its rigid body component and its vibration component becomes a problem; low pass filters take too long for satisfactory performance. Failure to properly separate the signal can cause the bench to run to the isolator stops, causing performance degradation. An active noise cancellation filter using strain gauges (which have no rigid body component) as the reference signal was simulated with several different algorithms. The algorithms were tested under a variety of different frequency inputs and different modal frequencies of the body. A recursive least squares filter was found to give the fastest convergence and best results. A least means squares, on the other hand, gave unsatisfactory performance.

EVALUATION OF AN IMMOBILIZED CELL BIOREACTOR FOR DEGRADATION OF META- AND PARA-NITROBENZOATE

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Abstract

Meta- and para-nitrobenzoic acid (m-NBA, p-NBA) are pollutants found in waste streams from metal-stripping processes utilizing cyanide-free solvents. The Kelly AFB Industrial Waste Treatment Plant (IWTP) is currently incapable of removing these compounds from the waste water it receives because of (1) the presence of significant quantities of ethylenediamine, a preferred substrate, and (2) an upper limit of 4.5 hours on the hydraulic residence time in the IWTP. This work describes the enrichment and preliminary characterization of a microbial consortium capable of utilizing both m-NBA and p-NBA as sole carbon sources. Experimental results indicate that m-NBA degradation involves an oxidation pathway, while p-NBA degradative proceeds through a reductive pathway. This consortium was immobilized by entrapment in alginate beads and grown in a continuous-flow airlift reactor. Single substrate and mixed substrates were fed to the reactor. Conditions were varied to simulate different waste treatment scenarios: switching from one stripping solvent batch to another, starting up of the metal stripping process, mixed solvent batches, and changing the loading rate of substrate to the bioreactor. Results indicate that the nitrobenzoate fraction of the metal stripping waste can be effectively treated in a continuous-flow, immobilized-cell bioreactor with a hydraulic residence time well below 3 hours. Furthermore, the process can be operated over long periods (>250 hours) with little diminution of performance and responds rapidly to changes in substrate.

GROUND AND EXCITED STATE PROPERTIES OF LINEAR POLY(PHENYL) DI-METHYLENE

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Abstract

This paper presents *ab initio* (631G*) calculations for the properties of α,ω n(para)phenyl-dimethylenes with $n = 1,2,3$. These molecules have two potential radical centers separated by aromatic spacers and potentially have a variety of forms, including the paired electron quinodial form, a singlet or triplet biradical form and a pseudo-Jahn-Teller distorted form in with a spontaneous symmetry breaking and opposite charges on the potential radical centers. The former quinoidal structure is favored by electron pairing and charge separation rules, the others by resonance in the aromatic rings. I find that for $n = 1$ this molecule is quinoidal and for $n = 2,3$ the molecule constrained to a D_{2h} geometry is a singlet biradical and that the radical wavefunctions are largely confined to the potential radical centers. More extensive calculations in non-D_{2h} geometries have been done for the $n = 2$. The likely consequences for polymers which consist of such potential radical centers connected by aromatic segments and of polymers containing such radical centers are discussed.

Application of the Volterra Functional Series Approach for Understanding Control of Flow Separation Downstream of a Pitching Airfoil

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and

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Graduate Student

Abstract

A combination experimental/numerical investigation of flow separation for a static airfoil has been conducted using Higher-Order Spectral Analysis (HOS) and the Volterra functional series approach. Input and output time series were recorded downstream of the airfoil at certain points in the flow to investigate and quantize the natural energy transfer mechanisms present. Time series were recorded for two angles of attack, and hot-film anemometers were used to record input and output flow velocities downstream from the airfoil at various fractions of the chord length downstream. Linear and quadratic transfer functions were calculated for these trajectories. These functions were then examined for evidence of natural energy transfer mechanisms in the flow.

Following this analysis of the unforced flow, a study was conducted using pulsed air as a mechanism for control of flow separation. Linear and quadratic transfer functions were calculated for these test cases, and insights were obtained on the mechanism by which the angle of incipient flow separation is increased.

INTERACTION BETWEEN NITRIC OXIDE AND OXYGEN DURING HYPERBARIC OXYGENATION

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Abstract

The interactions between oxygen, nitric oxide and some of the effects of these interactions on the immune system and inflammatory response were identified. Hyperbaric oxygenation treatment was used to alter oxygen levels both in chronic and acute studies *in vivo* in both a human and rats. Microwave treatment was used to induce a shock response in rats. *In vitro* studies were used to supplement information gained from *in vivo* studies.

The effects of hyperbaric oxygenation treatment and microwave exposure on mitogenic stimulation of lymphocytes, nitrate production of macrophages, and time to induction of shock and death were determined in rats. The effects of hyperbaric oxygenation treatment on CD4/CD8 surface protein ratios, mitogenic stimulation of lymphocytes, and nitrate production of macrophages was tested in a human. Finally, the mitogenic and toxic effects of nitric oxide, 3-amino-tyrosine and glucose on human lymphocytes were measured.

UPDATING PROBABILISTIC DATABASES

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Abstract

A probabilistic database is a generalization of a relational database that replaces the characteristic function of a finite relation with a finite real- or interval-valued probability distribution. In this report, methods are explored for updating real-valued probabilistic databases in response to new information, reassessment by experts of certain probabilities, or in order to smooth a relative frequency distribution based on limited observations. A distinction is made between global updating, which involves selecting a member of the set of joint distributions each member of which has the given database as its projection, updating it appropriately, then projecting; and local updating, in which changes to one distribution are propagated to the others, in order to restore consistency of the database. The appropriateness of Jeffrey's Rule of conditioning for propagating local changes in probability is discussed. Schemes used for updating the probabilities associated with causal, or Bayesian, networks are shown to be applicable to probabilistic databases whose schemes are α-acyclic.

SEMICONDUCTOR COUPLED AMPLIFIERS FOR ELECTRO-OPTIC APPLICATIONS

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Abstract

Nonlinear optical phenomena are of interest because of their wide ranging applications. In particular I have investigated coupled semiconductor waveguides of interest in electro-optic applications. Because of the available semiconductor growth facilities in the area and their growing importance in research, particular attention was paid to the III-V semiconductor multiple quantum well materials.

AN EXPERIMENTAL AND NUMERICAL STUDY OF THERMAL CONDITIONS IN A HIGH PRESSURE SYSTEM FOR INDIUM PHOSPHIDE CRYSTAL GROWTH

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and
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Abstract

For one-step, in-situ synthesis of phosphorus vapor and indium melt, and liquid-encapsulated Czochralski growth of InP crystals to succeed and produce single crystals of uniform quality and at lesser cost, it is important to develop a basic understanding of the mechanics of heat transfer and gas flow in a high pressure crystal growth (HPCG) furnace. A series of experiments performed recently in order to characterize the temperature conditions at the graphite susceptor and crucible walls is reported here. These results demonstrate the variations in temperature profiles with the power input as well as with the crucible's vertical location. A computer model to study the gas flow in an HPCG furnace has also been developed. Numerical computations are performed to examine the gas flow and temperature fields with and without the presence of phosphorus injector inside the furnace. Complex recirculatory flows which become oscillatory at high Grashof numbers, are produced by the buoyancy forces. The temperature variations are generally very strong in the vicinity of the encapsulant surface, and weak in the outer region which agree qualitatively with the temperature measurements.

CONCEPTUAL DESIGN STUDY OF A SOLAR CONCENTRATOR/
SUPPORT STRUCTURE: A THREE DIMENSIONAL FINITE ELEMENT MODEL

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Abstract

Under the space environment the paraboloid solar concentrators and support structures can deform and hence the focal point of the concentrators can diffuse. If this diffusion is large, energy will not concentrate on the thruster as desired. This paper addresses this aspect of pointing and accuracy analysis of solar concentrators, due to equivalent thrust loads.

The previous studies were limited to the concentrator system being modeled with a simplified finite element model that includes only the support struts and torus. The torus model was made up of several equal length beams. The simple model did not contain the paraboloid reflector, and assumes the reflector does not affect the deformation of the torus. In the present study the inflated parabolic reflector is included in the model. The results demonstrate the non uniform displacements on the reflector that confirms the reflector's potato chipping effect.

DESIGN OF A STABILIZED CENTER-BODY COMBUSTOR

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ABSTRACT

The objective of the present work was to design a stable, low NO_x, high performance center-body combustor. Five different center-body configurations were studied experimentally to determine their performance characteristics under various operating conditions. The lean blow out limit in all the cases was found to be around 0.03 which is an order of magnitude lower than the present combustors in use. A multiple air-fuel jet configuration with independent control of the primary air showed a promising over-all performance and further tests are in progress to determine their emissions characteristics. Increased and controlled mixing was found to be the key factor in extending the operating range of the combustor.

Aircrew Training Management Systems: A Blueprint for Design and Development

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Abstract

Aircrew training is an important function in the Air Force, and is aimed at developing and maintaining the forces in a perpetual state of mission-readiness. The training is carried out intensively at both the formal training schools and the field units of the Air Force. This requires a considerable committment of resources and the co-ordination of several training-related activities. The growing complexity of the training programs, warfare technology and the training management strategies in the Air Force have continuously underscored the importance of system integration in the management of training programs. The concept of a Training management System (TMS) is an offshoot of this. While the interpretations of a TMS may vary, a TMS in general, can be defined as an information/decision support system for a training organization, that supports and integrates the organizational functions in an efficient and cost-effective manner. The purpose of the current study is to formalize this definition and develop a blueprint for the standardization and structured development of a TMS in general for the Air Force. This objective is accomplished by developing the specifications for a TMS at an appropriate level of detail, and illustrating the standards by adapting them to the support requirements of the 542^{nd} CTW, Kirtland AFB. Detailed specifications for the 542^{nd} CTW have been developed, and the next set of logical stages in system development have been outlined. The proposed standards should serve as a frame of reference for all future TMS development in the Air Force. This report is a condensation of the TMS model specifications provided in the comprehensive report submitted to the Armstrong Laboratory at Williams AFB and the 542^{nd} CTW. The reader is referred to the comprehensive report for the details of these specifications, which may be obtained from either the Armstrong Laboratory or the 542^{nd} CTW.

MODELING OF THE EJECTION PROCESS

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Abstract

A pilot is ejected from the aircraft. The equations modeling this process are written and solved analytically. Recommendations are given for the safe ejection on the basis of the above analysis. Suggestions are made concerning the choice of the optimal parameters for the safe ejection.

An Ergonomic Study
of
Aircraft Sheetmetal Work

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ABSTRACT

Ergonomic risk factors of aircraft sheetmetal tasks were studied at Kelly Air Force Base in San Antonio, Texas. It was observed that most of the tasks performed by the workers involved fairly high risk of developing cumulative trauma disorders (CTDs) of the upper limbs. An ergonomic screening questionnaire filled out by workers indicated a prevalence of mild forms of CTDs among 77% of the workers. Control measures were recommended to reduce progress and/or development of CTDs; a training program in basic Ergonomics was also suggested as a means to make workers aware of CTD and increase adherence to recommended improvements in work methods. When implemented, the recommended control measures will have a positive effect on sheetmetal worker health and help to reduce future compensation claims associated with CTDs.

A METHODOLOGY FOR QUANTITATIVE ASSESSMENT OF THE EFFECT OF INNOVATIVE BUSINESS PRACTICES ON SYSTEM LIFE CYCLE COSTS

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ABSTRACT

This paper presents a general approach for quantifying and assessing business practices [8,9]. The methodology is aimed at addressing high level broad scope situations a company may encounter [4,5]. Usually, mathematically or statistically based techniques have proven to be inappropriate, inadequate, or inaccurate when attempting to solve such problems [4,5,6,7]. The difficulties experienced in using these approaches have been alleviated by prescribing a logical series of general steps. These steps may be modified to fit the prevailing circumstances and data of an organization. A brief description of the steps, which form the methodology, is provided.

The majority of this paper discusses the application of the methodology to an actual business environment. The approach was used to develop a quantitative model for the acquisition of fixed wing military aircraft. A quantitative model of the business process was derived from official Department of Defense (DoD) directives [2,3]. Data used by the model came from actual cost figures for aircraft that were purchased by the Air Force, Army, and Navy over a forty year period [1]. These data represent forty-one aircraft types that were acquired at a cost of 238 billion dollars. A computer simulation program of the acquisition process, which uses the actual cost data, was developed.

A Methodology for Missile Autopilot Performance Enhancement in the Presence of Multiple Hard Nonlinearities

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1 Abstract

The primary goal of this research effort has been to develop systematic design methods for enhancing the performance of missile autopilots. To focus the research, efforts have concentrated on the important problem of guaranteeing performance in the presence of multiple hard nonlinearities. Hard nonlinearities include, for example, saturating actuators, rate limiters, etc. Traditionally, engineers have accommodated such nonlinearities by "extending" single-input single-output (SISO) ideas, using "engineering judgement", and conducting extensive simulation. Because the SISO ideas do not extend well to multiple-input multiple-output (MIMO) problems, the techniques used have not been systematic and, more than often, have resulted in overly conservative designs. The methods developed in this research systematize the design process without sacrificing performance. More specifically, the methods are applied to an EMRAAT BTT missile with saturating actuators. It is shown that the introduced *performance enhancement system* significantly improves autopilot performance by maintaining desired directionality properties, eliminating wind-up effects, and above all guaranteeing stability.

CONDUCTED INTERFERENCE MEASUREMENT RESULTS FOR A GENERAL ELECTRIC CORPORATION SOFT PART ANALOGOUS MODULE (SPAM)

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Abstract

Conducted electromagnetic interference (EMI) measurements were performed on a General Electric (GE) Corporation Soft Part Analogous Module (SPAM) [1]. The SPAM is a high speed 1-megabit random access memory (RAM) that was built by GE to verify multi-chip-module (MCM) fabrication techniques and processes prior to full construction of radiation hardened MCM's. Measurements and simulations were also performed on the individual integrated circuits (IC's) within the MCM in order to determine if simpler and less expensive IC's could be evaluated prior to testing a more complex and costly MCM. This report discusses the conducted EMI measurements performed on the GE SPAM and the SPAM interface IC's while the simulation results are discussed in Reference 2.

A STUDY OF RAW DATA FUSION USING ARTIFICIAL NEURAL NETWORKS

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Abstract

A study of raw data fusion using neural networks was begun in Summer 1992. This is a continuation and extension of that work. It is determined that target identification (classification) can be performed by a neural network. For the particular data set that is used in these studies (the AADMS data set), identification based on IR data alone is quite good. The neural network performance degrades when MMW and IR data are used (fusion). It has been found necessary to segment out the target-related MMW data from the rest of the data file as is done with the IR data, but it is not clear that this can be done given the format of the AADMS data. Therefore, other data sets, including data from low-observable subsonic aircraft tower tests (LOSA) and some laser radar (LADAR) data have been processed for possible future use.

Details of the computer software and the data file file formats are provided. This software and data had to be transported on various media from their original sources, so the re-installation process was quite time - consuming, and will be a continuing process for some time to come.

A comparison of neural network performance with classical approaches is made. Neural network operating principles include many terms that we usually ascribe to human behavior, including learning, instinct, intuition, judgement, and confidence level. Like human performance, the accuracy of neural net performance is dependent upon training. With sufficient training, highly accurate responses are obtained at high speed.

Several ideas for commercialization and technology transfer utilizing neural network -based raw data fusion are proposed, including robotics, engine diagnostics, underwater detection, chemical analysis, voice processing, and automatic facial recognition.

On the Maximization of the Semi-Major Axis a
of a Maneuverable Satellite Moving Initially
in a Circular Orbit about the Earth

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ABSTRACT

Problem Statement: Consider a satellite moving in a circular orbit about the earth. At time t = 0, it's thruster is turned on and remains on for a total burn time T_{BT} then turned off. Assume one can control the direction of the thrust vector $\vec{f}$ relative to the velocity vector $\vec{V}$. (of the satellite) Assume α (t) is the angle between $\vec{f}$ and $\vec{v}$. We assume all vectors act thru the center of mass = center of gravity of the satellite. Within a given class of controls α (t), does there exist a control α (t) in our class that will maximize the semi-major axis a of the elliptical path followed by the center of mass of the satellite in the time frame after T_{BT} ?

We formulated then solved the above problem. We now state the results of our research in what follows:

1. $a_{max} = a_0 + \Delta a_{max}$ where,

2. $\Delta a_{max} = \dfrac{2a_0 f\, T_{BT}}{V_0 M_0}$ where,

   a_0 = semi-major axis at t = 0, V_0 = velocity of the satellite at time t = 0, f = magnitude of the thrust vector $\vec{f}$, M_0 = mass of the satellite at t = 0. We assume all quantities on the right side of 2. are positive.

3. The maximizing control is $\alpha(t) = 0$ for $0 \leq t \leq T_{BT}$.
   I.E. one keeps the thrust vector $\vec{f}$ and velocity vector $\vec{V}$ aligned during the burn.

4. $\alpha(t)$ of 3. is unique i.e. there is one and only one maximizing control and further this control is a global maximizing control.

5. Our control class also includes bang-bang controls in the competition. (Reference 1. assumes a class of linear controls.)

WARPING OF FLAT COMPOSITE ISOGRID PANELS DURING CURE

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Abstract

This report describes the work done to determine why nominally flat composite isogrid panels designed for the Clementine satellite were warping during autoclave curing. Analytical models indicated that the largest factor was the mismatch in the coefficients of thermal expansion of different parts of the tooling. The next most important factor was the mismatch between the skin and rib materials of the isogrid itself. New tooling was designed to eliminate the first factor, and successfully used to make a ribs-only panel with no warping. An analytical model developed in the project predicted that warping caused by the rib-skin mismatch would be 0.13 in, over a length of 58 in. A panel with skin was manufactured and found to have a warp of 0.15 in. Further improvements in producing flat panels will depend on finding appropriate materials for the rib and skin.

MODE BEATING IN IODINE LASERS

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Abstract

The potentials of iodine lasers to exhibit mode-beating in the GHz range was explored. A photolytic iodine laser pumped by an excimer laser was built. To study the temporal behavior of the laser output with picosecond resolution a streak camera was implemented. A short cavity dye laser served to test the streak camera and to find a suitable trigger mechanism. A computer simulation of the photolytic laser suggests several possibilities to achieve mode beating. Preliminary results indicate a strong dependence between laser transients and certain relaxation parameters of the active medium. Therefore, a comparison of measured and simulated data is expected to provide information on the latter.

EVALUATION OF HEXAMETHYLENE DIISOCYANATE SAMPLING AND ANALYSIS IN SPRAY-PAINTING OPERATIONS

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Abstract

Several methods were used for the analysis of 1,6-hexamethylene diisocyanate, HDI, monomer and oligomer. Samples were collected during several spray-painting operations, and two impinger collection methods were compared with fiber filter, sorbent and total particulate collection methods.

The results demonstrate that the impinger collection methods, NIOSH Method 5521 and a new NIOSH method for Isocyanates, give higher results than those which employ a 1-(2-pyridyl)-piperazine-coated filter (OSHA Method 42) or a tryptamine-coated XAD-2 sorbent tube.

The results also indicate that capillary zone electrophoresis may be used as an analytical tool for the separation of 1-(2-pyridyl)-piperazine-derivatized HDI, and may offer better resolution than HPLC when HDI is in a complicated polyurethane paint matrix.

Finally, the results from total particulate sampling indicate that the concentration of polyisocyanate in air may be estimated (within a factor of two) from the relative amount of hardener in the paint formulation.

THE AMPLL PROGRAM FOR PREDICTING PENETRATOR BEHAVIOR ON IMPACT

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Abstract

This report describes a computer program called AMPLL (Analytical Model for Penetration with Lateral Loads). AMPLL is designed to predict the structural response of a penetrator passing through layers of air, concrete, soil, ice, and/or rock. AMPLL is based on a similar program developed by Sandia National Laboratories called SAMPLL. AMPLL differs from SAMPLL in that it has a more extensive graphical user interface and models the penetrator as a flexible body rather than a rigid body. Axial forces and lateral loads due to angle of attack and impact angle are treated. The penetrator is modeled as a series of frame finite elements, the number of which can be controlled by the user. Penetrators with arbitrary (but quasi-axisymmetric) and varying cross sections can be modeled. Plastic behavior of the penetrator is treated in an approximate fashion.

AMPLL is written in Microsoft Visual BASIC and runs on personal computers under Microsoft Windows. The structure of the program and how it can be used is described.

EFFECT OF TOLUENE INHALATION ON THE HYPOTHALAMIC-PITUITARY-OVARIAN ENDOCRINE AXIS IN THE CYCLING RAT

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Abstract

Menstrual disorders and miscarriages in women exposed to toluene in workplaces have been reported. The male rat has been extensively used to study the effects of toluene on reproductive hormones. The present study was designed to elucidate the effect of toluene inhalation on the estrous cycle and the associated neural and endocrine responses in female F_{344} rats. Three concentrations (100 ppm, 500 ppm and 1000 ppm) of toluene vapor was used. Control group (0 ppm) was exposed to air only. Rats were treated for 4 hours daily for 3 weeks. Daily vaginal cytology was examined to monitor the estrous cycles. Inhalation of toluene for 4 hours daily caused shortening of estrous cycles, elevation of serum enzymes and enlargement of liver. Analysis of various tissues will be performed to determine the effect of toluene on the neural, endocrine, hepatic and reproductive system.

DEBRIS CLOUD MATERIAL CHARACTERIZATION FOR HYPERVELOCITY IMPACTS OF MULTI-MATERIAL ROD PROJECTILES

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Abstract

In kinetic energy weapon impacts, one or more debris clouds are created during the perforation of a target outer wall. These debris clouds expand as they move through target voids and eventually impact interior components of the target. Depending on the engagement conditions and the properties of the projectile and target materials, these debris clouds can contain solid, melted, and vaporized material. To accurately predict principle damage mechanisms and in turn the damage and break-up of targets engaged by kinetic energy weapons, the percentages of debris cloud material in each of these three states of matter must be determined. This report presents a methodology to calculate 1) the amount of debris cloud material that is solid, molten, and vaporous, 2) the debris cloud leading edge, trailing edge, center-of-mass, and expansion velocities, and 3) the angular spread of the debris cloud material. The predictions of the method are compared against empirically-based lethality assessment scheme predictions and against numerical and experimental results.

Estimation of the Squared Modulus of the Complex Coherence Factor from Amplitude or Intensity Measurements at High Light-Levels

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Abstract

Lower bounds are presented for the variance of any unbiased estimator of the squared modulus of the complex coherence factor from amplitude or intensity measurements when the fluctuations of the complex-valued amplitude are governed by circular Gaussian statistics, and when the light level is high enough that all non-classical fluctuations of the measurements can be ignored. For both amplitude and intensity measurements, this bound is compared with the variance of some common estimators along with the variance of the maximum-likelihood estimators. Additionally, the lower bounds for amplitude and intensity measurements are compared, and the signal-to-noise ratio gain that an unbiased estimator that optimally processes amplitude measurements can obtain over an unbiased estimator that optimally processes intensity measurements is examined.

A NEW MODELING TECHNIQUE FOR PIEZOELECTRICALLY ACTUATED BEAMS

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ABSTRACT

A one dimensional theory is developed for modeling the analysis of beams containing piezoelectric sensors and actuators. The equation of motion and associated boundary conditions are derived for the vibrations of piezoelectrically actuated beams. A generalized variational principle is used to formulate the equation of motion, taking into account the interfacial shear stress concentration near the ends of the actuators. This is accomplished by introducing a "stress function" into the beam's compatibility relations. This function has its maximum value at the ends of a piezoelectric actuator and decays exponentially in the longitudinal direction. The effect of coupling between longitudinal deflection and bending deflection is investigated in the present study. For the practical applications, in according with the proposed beam theory, a one-dimensional finite element formulation is presented. The proposed beam theory as well as the finite element approach can be easily used in developing a formal two-dimensional theory for piezoelectrically actuated composite plates and shells or other physical systems.

DEVELOPING THE SOFTWARE FOR SEM-EDXA ANALYSES OF AIRBORNE INORGANIC FIBERS

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ABSTRACT

The health hazard posed by airborne asbestos fibers is well documented. Numerous analytical methods for their identification and characterization have also been published but Analytical procedures for other fibers are not as well defined and this project involved using the Amray 1820 Scanning Electron Microscope equipped with an Electron Dispersed X-ray Analyzer to overcome this deficiency in the methods used at the Armstrong Laboratory.

During a previous tenure at AL/OEA, the author and his colleagues used a number of fiber standards to establish a basic fiber identification library. However, the procedures were cumbersome for characterized the fibers and no one except the author was able to determine many fibers.

During the current fellowship the library was expanded and four user friendly computer programs were written in the C++ format for fiber/mineral identification. In preliminary trials, approximately 90% of the material were identified on samples containing more than 30 fibers/100 fields (NIOSH 7400). A base report program has also been prepared so that fiber analyses are a routine procedure for the Al/OEAO asbestos function.

EQUATION OF STATE FOR HYPERVELOCITY COLLISIONS WITH HOMOGENEOUS MATERIALS

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ABSTRACT

Shock data from collisions of hypervelocity particles with homogeneous materials were evaluated. A master equation for shock that relates the reduced pressure and reduced particle velocity was established:

$$P/(\rho_0 C^2) = (U_p/C)(1 + sU_p/C)$$

where P = Shock Pressure,

ρ_0 = density,

C = Bulk Sound Velocity,

U_p = Particle Velocity, and

s = the Slope of the U_s Vs U_p line.

A universal slope for the linear relation between the shock velocity U_s and the particle velocity U_p was also established. The slope was estimated to have a value of 1.333 for all of the materials evaluated. Comparisons of the slopes were made for different crystal structures, face-centered-cubic versus body-centered-cubic, and for different crystal orientations of single crystals of NaCl. All slopes were found to conform to previously established universal slope for shock. Comparisons to another liquid also exhibited conformance to the master equation above and to the universal slope. The linearity and universality of the slope is related to the shape of the potential energy equation between chemical species in a homogeneous material. The universal value was calculated using the Lennard-Jones interactive potential between chemical species in a homogeneous material. The theoretical value calculated from the Lennard-Jones equation was between 1:4 to 1.6 which compares favorably with the value of 1.333 obtained from the data analysis.

IPToolkit: An Image Processing Environment for the X Window System

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Abstract

A prototype for an image processing subroutine library, tailored to the X Window System, is presented. This library, called the IPToolkit, is designed so that a comprehensive selection of image processing, visualization, and analysis operations can be integrated into larger software systems with minimal cost and effort. This package currently contains three modules: an input/output interface to grayscale and 24 bit color TIFF images (IOManager), an image processing module (IPRoutines), and a visualization module that interfaces with the X Window System (VPManager).

PHASE RETRIEVAL VIA SENSOR FUSION IN INTERFEROMETRIC APERTURE SYNTHESIS

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Abstract

The objective of this work was to develop signal processing algorithms to remove phase ambiguity in interferomteric aperture synthesis for celestial imaging. A phase retrieval algorithm was developed and implemented that utilized the target information on the image plane from a smaller aperture, e.g., a telescope. The magnitude information in the target's spatial frequency domain obtained from the larger synthetic aperture were fused with the image plane data from the telescope to form an image that had the resolution of the synthesized aperture.

MASTERMIND: Modeling and Simulation Technology Enhancement for Research in Multimedia Intelligent Network Domains

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ABSTRACT

This paper introduces new concepts in query processing needed to support construction of models from existing component submodels which are stored in a distributed model database management system (MDBMS). Dynamic execution of submodels provides the basis for evaluation of global model constraints specified as part of the model database query or global model specification. The paper describes a network service approach to modeling and simulation which was developed to support the evolution of standard interfaces and component model implementations required by a MDBMS. The MDBMS research direction presented in this paper is part of a strategy that the Modeling and Simulation Office at Rome Laboratory is pursuing to address the problems of model interoperability, reusability and construction of models that operate with varying degrees of fidelity.

AN EVALUATION OF HYDRAZINE DATA FOR THE NEQPAK DATABASE

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Abstract

NEQPAK is a FORTRAN subroutine package which calculates chemical species information for use in flow programs needed in computational fluid dynamics work. The input to the subroutines includes thermodynamic, transport and reaction rate data for the species involved in the particular environment studied. The objective of this research was to collect published data on hydrazine and construct a properties database which is appropriate for the model assumptions used in NEQPAK.

Janusz Starzyk's report not available at time of publication.

IMAGE PROCESSING TOOLKIT

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Abstract

For effective exploitation of digital imagery data it is essential to process the data using a variety of techniques. The algorithms through which the data needs to be run depends on the source of the data, the environment in which it was collected and the goals of the exploitation task. If the data is noisy, filtering is needed. For better visualization of the imagery, enhancement is needed. For characterization of data, features needs to extracted. In order to segment the image into regions of interest, classifying routines are needed. Thus there is great need for a collection of image processing routines which can easily and effectively used on a variety of data. This project entailed the design, creation and documentation of an image processing toolkit. The basic form of the toolkit was established, basic image processing routines were implemented and flexibility was added so that additional routines can be added as they are developed.

A UNIFORM DIELECTRIC LENS FOR LAUNCHING A SPHEROIDAL WAVE INTO A PARABOLOIDAL REFLECTOR

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Abstract

In this paper we consider dielectric-lens designs for the specific case of launching an approximate spherical TEM wave onto an impulse radiating antenna (IRA). Restrictions on launch angles are derived yielding a range of acceptable lens parameters. An equal transit-time condition on ray paths is imposed to ensure the correct spherical wavefront. Some reflections, ideally small, at the lens boundary are allowed. Illustrations and numerical tables are presented from which examples of these lenses may be constructed.

AN INTERFACE INTEGRATED CIRCUIT FOR A DIGITAL SIGNAL PROCESSOR MULTI CHIP MODULE

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Abstract

An interface Integrated Circuit (IC) was partially designed using VHDL. The IC worked within an "element", an element containing two memory ICs and two processor ICs. This IC interfaced an element to an external host processor via a futurebus, a data bus from external sensors and a bus internal to the element. Elements are packaged within a Multi-Chip Module (MCM) containing either four or sixteen elements. The system supports boundary scan testing.

The MCMs are a digital signal processing system to be used for fire control, space, Kalman filtering and fast Fourier transforms applications [1].

CASCADABLE OPTICAL LOGIC GATES BASED ON DETECTOR DRIVEN Q-SWITCHED LASERS

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Abstract

Optical OR and NOR gates were developed using Q-switched GaAs/AlGaAs diode lasers driven directly by photo detectors. The Q-switched lasers were designed and fabricated. Both optical logic functions were demonstrated. In the OR gate, an on-off ratio of ~1000:1 was observed using a multi-mode Q-switched laser, and an on-off ratio better than 10:1 was observed for single mode Q-switched lasers. The NOR gate on-off ratio was significantly less for the multi-mode Q-switched lasers. The power required to switch the single mode Q-switched lasers was less than one twentieth the lasers' output power.

ENTROPY GENERATION OF THE CARDIOVASCULAR CYCLE

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ABSTRACT

The primary aim of this research is to develop mathematical descriptions of the entropy generation of the cardiovascular system. To accomplish this aim, the cardiovascular cycle is modeled by four discrete thermodynamic components - left and right heart, systemic and pulmonic circulation beds. Using the first two laws of thermodynamics, mathematical expressions for the irreversibility of the components are obtained. Blood flow pressure drop and extraction of metabolic fuel largely contribute to the irreversibility of the cardiovascular cycle. For the left and right heart the irreversibility is found to be due to compression losses in the ventricles, metabolic losses, and fluid flow pressure drop. In the systemic circulation, irreversibility was primarily due to fluid flow pressure drop and oxygen and fuel exchange with the tissue. Pulmonary circulation irreversibility was comprised of fluid flow pressure drop and oxygen exhange.

THE PRINCIPLE OF INCREASE OF CROSS-SECTIONAL AREA AND ITS APPLICATION TO THE FRAGMENTATION OF SATELLITES

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Abstract

The changes in the average cross-sectional areas of common regular solids upon fragmentation are calculated. It is shown that the average cross-sectional area of an idealized flat plate remained constant on fragmenting but those of all other types of solids increased. Two factors responsible for the increase in the average cross-sectional areas of solids are identified. For sheet materials, it is the curvature which causes the increase. For solid objects, the increase is due to the creation and exposure of new surfaces. For fragmentaions of real solids, a principle of increase of the average cross-sectional area is arrived at. Its similarity with the entropy principle is discussed. The fragmentation of solids is identified as an irreversible process and the average cross-sectional area is recognized as a measure of mechanical disorder. Finally, the increase of the average cross-sectional area is calculated for documented satellite fragmentation events, both in space and on ground. The results are in general agreement with our analysis.

CHARACTERIZATION OF AN INTENSIFIED CHARGE-COUPLED DEVICE (ICCD) CAMERA USED IN PLANAR LASER-INDUCED FLUORESCENCE (PLIF) STUDIES

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ABSTRACT

The optical properties of intensified charge-coupled device (ICCD) cameras used to record the ultraviolet fluorescence of nitric oxide (NO) during planar laser-induced fluorescence (PLIF) measurements of shock flows were studied. An experimental protocol using an integrating sphere and a mechanical shutter was developed to facilitate the collection of the flat-field calibration images. This setup can be used with any camera for flat-field calibration. C language programs for the analysis of the calibration images, as well as subsequent flat-field correction of images, were written. These techniques were applied to two cameras in both the visible and the ultraviolet wavelengths. The uncorrected flat-field response of these cameras was found to vary by as much as 50% across the 578x384-pixel image; however, the variation was stable and correctable. Variation after correction was typically 10% or better, with the remaining variation attributable to noise present in the intensifier.

PHOTOCONDUCTIVITY AND RELATED STUDIES OF THE LADDER POLYMER POLYBENZIMIDAZOBENZOPHENANTHROLINE (BBL)

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Abstract

Polybenzimidazobenzophenanthroline(BBL) is a ladder polymer that offers hope of electronically conducting polymers for future applications. Some of the electro-optical properties of BBL have been investigated by photoconductivity and related measurements. BBL exhibits a characteristic spectrum, with a low-energy peak near 1.8 eV, and other structure. The dependence of the BBL spectra upon chopping frequency of the pump beam and applied electric field has been investigated. The PC response of BBL was found to be dependent upon both; however, the chopping frequency dependence is the more interesting. At low chopping frequencies (~ 10 Hz), a single exponential behavior was observed, while at higher chopping frequencies an inverse power law response was noted.

Attempts were made to measure the carrier lifetime and mobility of BBL by pulsed laser, time of flight experiments. Instrumental limitations caused limited success, however, a photo-induced transient signal was observed that is believed to be characteristic of BBL.

Y. Thio's report not available at time of publication.

BUILT-IN SELF-TESTING OF RANDOM-ACCESS MEMORIES

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Abstract

In this research, the problem of testing random-access memories (RAM) is considered. Due to the increasing density of RAM chips, built-in self-testing (BIST) has to be applied in order to save the time and cost of testing. Pseudo-random testing is evaluated as a BIST structure for RAMs. The fault coverage and test length of random testing for RAM is studied. The results show that pseudo-random testing is suitable for testing RAM using BIST.

PREDICTING EASE OF MOVEMENT BETWEEN AIR FORCE SPECIALTIES

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ABSTRACT

The current study focused on the prediction of ease of movement between 43 Air Force specialties. Nine possible predictors were examined, but only four variables, two dealing with job difficulty and two dealing with job similarity, consistently explained between 30 and 32 percent of the variance. The regression equations suggest that it is easier to move to a specialty that is lower in difficulty but similar to one's current specialty. Examination of individual specialties revealed that these predictors worked best when examining ease of movement from a specific specialty to other specialties rather than from other specialties to a specific specialty. Exceptions to these findings are noted.

COLLOCATED INDEPENDENT MODAL CONTROL WITH SELF–SENSING ORTHOGONAL PIEZOELECTRIC ACTUATORS

(Theory and Experiment)

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ABSTRACT

Distributed self–sensing piezoelectric actuators provide a perfect collocation of sensors and actuators in closed–loop structural controls. To achieve independent control of various natural modes, spatially distributed self–sensing orthogonal piezoelectric actuators are proposed in this study. A generic spatially shaped orthogonal sensor/actuator theory is derived first, followed by an application to a Bernoulli–Euler beam. Spatially distributed orthogonal sensors/actuators are designed based on the modal strain functions and they are fabricated using a 40μm piezoelectric polymer. A cantilever beam laminated with these self–sensing orthogonal piezoelectric actuators is tested. Collocated independent modal control of the cantilever beam with spatially distributed self–sensing orthogonal actuators is demonstrated and control effectiveness studied.

SOIL COLUMN STUDIES WITH A FIBER-OPTIC LASER SPECTROMETER

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Abstract

A fiber-optic laser spectrometer was used in soil column experiments to study transport of contaminants through soils. A unique fiber-optic laser probe was adapted into a modular stainless-steel column system so that the probe could be used to study the transport of fluorescent contaminants through soils in the column. It was verified that the probe performed well when sealed inside a soil column. Retention characteristics of naphthalene and amino G acid (7-amino-1,3-naphthalene disulfonic acid) on washed sand in columns were determined: amino G acid passed through the column quickly while naphthalene was retained for a significant period of time. A procedure for ensuring accurate calibration of the laser spectrometer was delineated. It was found that low levels of suspended solids do not interfere significantly with the fluorescence of amino G acid. Moderate levels of suspended solids were compensated for by using turbidity measurements made with the laser probe.

Development of Air Force Superconductivity Power Technology

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Abstract

This study is an extension of previous research on Superconductive Magnetic Energy Storage (SMES) technique, carried out last summer. As superconductor market gradually matures, it is necessary to examine other superconductive power techniques such as generators, motors, transformers, chokes, and power lines. Following criteria are applied in the evaluation: efficiency, weight, size, cost, durability, maintainability, and operability. Based on existing status of air base power system, it is suggested that superconductive rotational machinery (>300 KW) is beneficial, and other power devices may be beneficial. Besides further feasibility study, in-house experimentation at an air base is needed to make realistic assessment. In particular, tests on high Tc superconductors, wires and coils are required. Based on estimated savings, it is suggested that R&D funding on Air Force superconductive generators should be approximately one million dollars in 1994-5, which is approximately 0.28% of federal R&D funding on superconductors. Research on superconductive power systems is a suitable topic for air base engineers/scientists due to following reasons: 1. emphasis on mobility and critical needs on new power systems; 2. federal government's requirement on high tech development and military/civilian dual usage.

Philip Whitefield's report not available at time of publication.

LARGE-SCALE CORONAL MAGNETIC FIELDS: NOISE STORMS, SOFT X-RAYS AND INVERSION OF RADIO POLARIZATION

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Abstract

Large-scale coronal magnetic fields can link widely-separated active regions in opposite hemispheres of the Sun. The presence of such features are inferred from Very Large Array (VLA) observations of noise storms located within them; by Yohkoh Soft X-ray Telescope (SXT) images that delineate their magnetic structure; and by RATAN 600 spectral observations of inversions of the circularly-polarized radio emission that can be used to infer the coronal magnetic field strength. Extrapolations of photospheric magnetic fields to coronal heights indicate that non-potential, or current-amplified, magnetic fields are, in some cases, required to explain the polarization inversions. These anomalously high magnetic fields are also located at the source of the noise storm; such storms require long-lasting (hours) non-thermal particle acceleration.

ACTIVATED REACTIVE LASER DEPOSITION OF GeO_2 FILMS

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Abstract

Laser ablation technique has been used to grow amorphous GeO_2 optical films in an oxygen ambient. Application of a partially ionized oxygen plasma facilitated stoichiometric film growth in a low ambient pressures. Emission spectroscopy of the plume revealed an enhancement in the ionic and the neutral excited species as well as the atomic oxygen in presence of the plasma. Though the effect of the plasma on the gas phase reaction was insignificant, the substrate surface reaction was enhanced considerably. This technique enabled stoichiometric film growth in 30 mT oxygen pressure and 300 ^{o}C substrate temperature. Deposition at this low pressure produced uniform films over a large area, that are suitable for waveguide fabrication. Dependence of the film oxygen content on the ambient gas pressure, the substrate temperature, and the plasma conditions is discussed.

Criteria for Training Evaluation: Conceptual and Operational Perspectives

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Abstract

A general criterion construct model specific to training evaluation is developed and presented. This training evaluation criterion model builds on both the training evaluation and criterion development literature to present a broad-based conceptualization of the criterion domain for training evaluation. Relevant boundary conditions that impact the effect of training interventions on various outcomes are discussed. In addition, a distribution-based measurement approach is presented as a way to improve the utility of organization level criterion measures.

COMPREHENSIVE ANALYSIS OF SWITCHED RELUCTANCE MACHINE BY THE COUPLED FIELD AND CIRCUIT MODELING METHOD

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The Ohio State University

Abstract

One of the very important research topics in a switched reluctance machine (SRM) system is its complicated dynamics under various transient or fault conditions. These transients or faults impact not only the SRM magnetic field internally but also the associated power control circuit externally. In this research project, a computer model including the power electronic converter, control circuits and the nonlinear magnetic field of the SRM is established. Finite element method is used to model the nonlinear magnetic field of the SRM. The SRM field model is further tightly coupled to the circuit model of the overall system. With simultaneous computation over the entire system including the SRM magnetic field and power converter circuit, the proposed computer model provides a powerful computer tool to investigate the SRM system extensively. Initial experimental results are presented to validate the computer model.

EFFECT OF FREE STREAM TURBULENCE ON THE BURST PHENOMENA AT THE WALL IN A WALL-JET

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Abstract

Effects of free stream turbulence (FST) on the burst phenomena at the wall was studied in a wall-jet flow. It was found that the number of bursts and/or ejections associated with a burst event per unit time increases with increasing intensity of FST. This fact can be used as an explanation of why FST results in an increase in the heat transfer at the wall. For this purpose a wall-jet test rig was designed and built. The initial height and velocity of the jet were 4" and 73.5 ft./s respectively. The ejection processes associated with a burst event were identified from the output of a surface flush hot-film probe positioned at 4" intervals on the surface along the flow direction. The profiles of mean velocity, axial component of the turbulent stress were measured with a horizontal hot-wire probe. Autocorrelations were used to calculate the length scales in the flow direction. Two horizontal hot-wire probes were used for the measurement of length scales in the spanwise and vertical directions. Large amounts of data were collected. Apart from the important result of increase in the rate of ejections with increasing FST intensity, further analysis of data is expected to reveal some of the fundamental mechanisms through which FST affects the rate of heat transfer.

Second Order Optical Nonlinearity near the Bandgap of Zincblende Crystals

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Abstract

We have studied the near-bandgap second order optical nonlinearities of several semiconductors possessing the zincblende structure. Specifically, we concentrated on difference-frequency generation (DFG) and sum-frequency generation (SFG). We simultaneously measured the DFG radiation field and the SFG intensity as a function of crystallographic orientation and incident photon energy. To perform the measurements, we select <100>, <110>, and <111> orientated samples of GaAs, InP and CdTe. Herein, the pronounced near-bandgap resonant behaviors of both DFG and SFG are compared for the first time.

NEW DISCRETIZATION METHODS AND ITS APPLICATIONS IN MISSILE AUTOPILOT CONTROL

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Abstract

This paper considers the sampled-data controller design using discretization method. The work described here is motivated from the fact that the conventional textbook discretization methods do not take into consideration of the effects of the antialiasing filters and the hold devices on the system performance, which may lead to severe performance deterioration when the sampling is not very fast. In this paper, we propose several simple alternative discretization methods which compensates the performance deterioration. Our methods are inspired by the fact that the sampled-data controller (including the antialiasing filters and the hold devices) can be bounded by a conic sector with a linear time invariant optimal center. The fundamental idea of our methods is to discretize the continuous controller in such a way that the frequency response of the optimal center for the sampled-data controller approximates the frequency response of the continuous controller. This paper considers only some theoretical development of the proposed methods. The applications of these methods in the missile autopilot control will be reported in the subsequent research.

A PROBABILITY MODEL

FOR PREDICTION OF IMPACT WITH SPACE DEBRIS

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Abstract

The increased danger space debris presents to a functional spacecraft resulting from its population growth has pressed the associated scientific community to investigate related problems influencing future space flights. This report focuses on the problem of determining a method to compute the probability of an impact between a two objects in a space trajectory during a given time period. The paper presents a solution to this problem under the assumptions that the flux level is known for a given time period and region defined by the trajectory. The relationship between flux and probability as given in this paper assumes the debris distribution is static, that is fixed. For completeness a short review highlighting the physical description of the phenomenon is presented in the form of a model used to estimate the flux.

ELECTRIC FIELD MEASUREMENT BY USING ELECTROOPTIC SAMPLING SYSTEM

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Abstract

The electric field has been measured by using electrooptic sampling system. The system uses an $LiTaO_3$ electrooptical crystal and a YAG laser pumped by a laser diode whose output power is 13 mW to measure the electrical field of RF sources. An applied electric field nearby the $LiTaO_2$ crystal changes the polarization state of YAG laser beam as it propagates through it. The output emerging beam of the $LiTaO_3$ has been characterized. A wideband photodetector and a high frequency signal detector have been used to detect the change in the polarization fields at varies values of the electric field applied nearby the $LiTaO_3$ crystal. A computer program (MathCad) has been developed to verify the accuracy of the system.

AN EXPERIMENTAL AND NUMERICAL STUDY OF THERMAL CONDITIONS IN A HIGH PRESSURE SYSTEM FOR INDIUM PHOSPHIDE CRYSTAL GROWTH

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and
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Abstract

For one-step, in-situ synthesis of phosphorus vapor and indium melt, and liquid-encapsulated Czochralski growth of InP crystals to succeed and produce single crystals of uniform quality and at lesser cost, it is important to develop a basic understanding of the mechanics of heat transfer and gas flow in a high pressure crystal growth (HPCG) furnace. A series of experiments performed recently in order to characterize the temperature conditions at the graphite susceptor and crucible walls is reported here. These results demonstrate the variations in temperature profiles with the power input as well as with the crucible's vertical location. A computer model to study the gas flow in an HPCG furnace has also been developed. Numerical computations are performed to examine the gas flow and temperature fields with and without the presence of phosphorus injector inside the furnace. Complex recirculatory flows which become oscillatory at high Grashof numbers, are produced by the buoyancy forces. The temperature variations are generally very strong in the vicinity of the encapsulant surface, and weak in the outer region which agree qualitatively with the temperature measurements.

PARALLEL TURBINE ENGINE INSTRUMENTATION SYSTEM

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Abstract

The complexity of modern turbine engines requires significant amounts testing to ensure correct, cost effective development. Ground testing enables highly accurate control over the external conditions along with the ability to acquire a large number of measurements of internal structures.

Analysis of turbine engine testing data is a computationally intensive, dynamic process. The combination of high bandwidths, large numbers of channels, and constantly changing processing requirements place many demands on an instrumentation and data analysis system.

The Computer Assisted Dynamic Data Acquisition and Monitoring System(CADDMAS), developed in conjunction with Arnold Engineering Development Center, has been in operation for several months in support of simulated altitude turbine engine stress testing. The system uses parallel processing to sustain over 400 million floating point operations per second(MFLOPS) producing on-line data analysis plots, such as Campbell Diagrams, Phase Campbell Diagrams, and spectral energy plots. Until recently, these plots took several weeks to obtain. The plots are displayed on multiple high speed color displays using standard engineering graphics. Hardcopy plots are available on demand.

I describe hardware and software architecture of a greater than 100 processor parallel instrumentation system for turbine engine aeromechanic stress analysis. The hardware consists of a mixture of hetereogeneous processing nodes arranged in a configuration closely matching the analysis algorithms. Specialized processors are used for numerical, input/output, graphics, user interface, and storage.

The software uses model-based program synthesis techniques to to dynammically reconfigure signal analysis algorithms to meet changing requirements.

TEMPLATE BASIS FOR 1-D
HIGH RANGE RESOLUTION
TARGET IDENTIFICATION

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Abstract

One dimensional high range resolution radar profiles for use as a template set for the identification of non cooperative targets were studied. In particular, three things were accomplished. A literature search was performed to find previous investigations in this area. The Xpatch software routine, developed by Wright Laboratory, was investigated for potential use as a tool for generating template sets. Real, high range resolution data was analyzed for use in further investigations. The results at this time are incomplete, although Xpatch shows much promise as a generator of the high range resolution template sets required. Further work needs to be done.

FORCED VIBRATION OF A TWO-SPAN FREE-FREE BEAM JOINED BY A NONLINEAR ROTATIONAL SPRING

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Abstract

The forced vibration characteristics of a two-span free-free beam joined by a nonlinear Duffing type rotational spring were investigated. The exact solutions of the linear problem were found and used as a basis to find an approximate solution to the nonlinear problem. This was accomplished by using a harmonic balance technique to handle the nonlinear boundary condition. The beam responses were determined for different nonlinear stiffness conditions for loadings at various frequencies. The relationship between amplitude and forcing frequency revealed a multiplicity of jump and oscillation hysteresis phenomena normally associated with Duffing type systems.

THE IMPACT OF CONDENSING WATER VAPOR IN CHEMICAL OXYGEN IODINE LASERS.

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and
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Abstract

This final report describes the results and interpretation of a joint research project sponsored by (i) AFOSR through its SRE, SFR and GSR programs and (ii) the University of Missouri - Rolla, to investigate the impact of condensing water vapor in the reacting flow regimes of chemical oxygen iodine lasers (COIL's). The "condensation shock phenomenon" first reported in 1991 has been successfully simulated and recreated under non-reacting flow conditions in two independent COIL devices. The two-phase singlet oxygen generator has been identified as the major source of particulates (condensation nuclei), especially those upon which heterogeneous nucleation can take place. These particulates have been characterized in terms of size distribution, total concentration, hydration and dependence on typical generator operating parameters such a chlorine flow rate, disc rotation rate, basic hydrogen peroxide concentration and temperature. Based on the heterogeneous nucleation characterization and known heat released into the laser supersonic flow during the "condensation shock" it is reasonable to conclude that both homogeneous and heterogeneous nucleation are responsible for water vapor condensation in the COIL devices, however, homogeneous nucleation is the dominant step in "condensation shock". Furthermore, the onset of the shock is readily observed at very low BHP temperatures.

A Comparison of Biasing Options in the Laser Multiphoton Ionization Detection of Methyl Radicals in a Filament-Assisted Chemical Vapor Deposition Reactor

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Abstract

An apparatus and procedures were developed for the detection of methyl radicals in a filament assisted chemical vapor deposition reactor operating with methane/hydrogen gas mixtures similar to those used in the generation of diamond-like carbon films. The apparatus was designed to detect small transient currents as the focussed output of a tunable dye laser ionizes methyl radicals between a hot filament and a deposition substrate. The current design incorporates the use of an electrode pair for ion collection, that may be translated between the filament and substrate. Results from two circuit designs with different bias geometries for ion collection are presented.

A MOLECULAR DYNAMICS SIMULATION OF ELECTROMIGRATION

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Abstract

A flexible model of polycrystalline metallization on integrated circuits was developed, and the construction of a computer simulation to study electromigration in such structures has begun. This work was part of an ongoing effort to determine whether microcircuit failure due to electromigration can be reduced or eliminated. Experiments have revealed that void formations in aluminum interconnections on integrated circuits result from current-induced transport of metal atoms [1]. A computer model is being developed to simulate this effect. The model will permit variation of boundary conditions, including grain size and orientation, thermal effects, crystallite composition, as well as interatomic potentials. The roles of grain boundaries and interstitial atoms are of particular interest since these are parameters that can be controlled, to some degree, during fabrication. The computer code is not complete; specific results are not reported. However, progress was made in the development of the model, and significant portions of the code have been written. A commitment to completion endures regardless of further support.

A PARTICLE IMAGE VELOCIMETRY TECHNIQUE FOR SPRAY INJECTORS

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Abstract

The droplet field produced by a liquid spray injector was studied using a Particle Image Velocimetry (PIV) technique. By pulsing a laser-sheet through the spray field parallel to the injector centerline, images consisting of droplet pairs were produced on a CCD camera oriented perpendicular to the laser-sheet. In knowing the time between the laser pulses, a two-dimensional droplet velocity vector map was retrieved from the digital image. Although the droplet size distribution will also be obtained from these images in the near future, this report only introduces the concept. This methodology was found to produce high quality images and very detailed velocity maps. The work presented here is the baseline for a more complex and comprehensive system being developed.

Superresolution of Passive Millimeter-Wave Images

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Abstract

Techniques for the reconstruction of millimeter-wave images were investigated. Computer simulations were run for constrained iterative deconvolution (CID) and fast constrained iterative deconvolution (FCID). A new approach to FCID is described. The results of each of these simulations are presented and their effectiveness is evaluated.

SIGNAL PROCESSING METHODS FOR SPECTRAL ESTIMATION USING SIGNAL SUBSPACE METHODS, AND ANGLE OF ARRIVAL ESTIMATION

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Abstract

The paper outlines two main tasks assigned during my employment as a graduate student research associate at the Wright Laboratory, Wright Paterson Air Force Base. Upon arrival at the Wright Laboratories, I was to investigate a method of signal processing, different from the common Fourier transform, in that inherent mathematical properties of the signal space are exploited in retrieving the spectrum of the signal. The two alternative signal processing methods investigated are the MUSIC and Minimum-Norm procedures for high resolution signal processing. The results of the investigation are included with a general comment section regarding the performance of the algorithms. The second main task assigned was the investigation of angle of arrival (AOA) calculation. Traditionally, methods such as beamforming have been used to estimate the AOA using arrays of sensors and sophisticated signal processing algorithms. We are curious as to whether the AOA can be measured using only two sensors and FFT processing measuring the phase difference of the signal at two adjacent sensors. Results of this study are presented with general comments as to the validity of the measuring paradigm.

Wavelet Transforms, Ambiguity Functions, and Radar

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Abstract

In radar systems, the response of the correlation receiver to the target return is typically described by the ambiguity function. The plot of this function is used in the extraction of information from the return signal. When the receiver is not the idealized matched filter, the function is referred to as the cross-ambiguity function. Wavelet transforms are essentially wideband cross-ambiguity functions (WBCAF) and can be used in a more efficient implementation structure of this function. Extending the concept of the wavelet transform is the chirplet transform. This transform embodies many other time-frequency (TF) and time-scale (TS) transforms and may provide greater resolution capabilities than transform methods generally employed.

Rapid Design Systems Features Development

Barry Caslin

Abstract

This paper describes the Feature-Based Design Environment of the Rapid Design System. As well as desired and realized updated under development.

The Rapid Design System

The Rapid Design System (RDS) is a project of the Materials Directorate, a unit of the Air Force's Wright Laboratory. The goal of the project is to reduce design and production time and improve quality, particularly for small lot size jobs. The technical approach is to couple feature-based design with a memory that can retrieve past designs based on similarities to the current design, providing a "corporate history" function that enables the designer to profit from the experience of the past.

Communication via Shared Memory

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Abstract

Interprocess communication has received much attention in recent years. Communication kernels have been developed to enable communication for many types of applications as well as generic systems. This paper provides a generic classification scheme for shared memory communication systems. Existing systems are discussed in the context of their classifications. The conclusion of this paper is that the scientific exploration of shared memory communication needs to be continued to further develop the classification scheme and eventually establish a design methodology.

Target Discrimination in a Geodesic Sphere

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Abstract

Auditorily aided visual localization tasks were compared with non-aided visual localization tasks in a geodesic sphere at 260 points. Reaction times were at their best when the sound was correlated (aided) with the visual target than when the sound and target were uncorrelated (unaided). Performance declined as the targets moved out into the periphery for both conditions, at an accelerated rate for the uncorrelated condition. When in the rear hemifield, performance for the correlated fell to almost 2 1/2 times what it was in the frontal field, while it was as much as 8 times for the uncorrelated condition. Preliminary tests using synthesized sound over headphones have proven to be about as accurate as the free-field correlated condition. This may have strong implications for the use of 3-D headphones in applications for cockpit designs and entertainment.

ON THE CALCULATION OF THE COMPONENTS OF THE RIEMANN TENSOR BY NEUTRAL PARTICLE INTERFEROMETRY

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Abstract

It is known that the six independent components of the electromagnetic field tensor may be determined by charged particle interferometry. The process may be thought of as sending the particles along six paths or loops through spacetime and observing the change in quantum phase as the particles traverse these loops. An analogous method for determining the components of the Riemann curvature tensor by means of neutral particle interferometry is examined. We wish to know if it is possible to construct enough spacetime loops to determine the twenty-one independent components of the Riemann tensor. This question remains open.

THE EFFECTS OF PREGNANE STEROIDS ON TRICHLOROETHYLENE METABOLISM IN RAT BRAIN MICROSOMES

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Abstract

The effect of chloroform and pregnan steroids on the metabolism of Trichloroethylene (TCE) in rat brain microsomes was assessed. Gas chromatography and a modified vial-equilibrium technique were used to assay TCE removal from headspace. Pregnane steroids are synthesized during pregnancy via P450-mediated metabolism and display anesthetic properties in the vertebrate central nervous system. Trichloroethylene is also metabolized by cytochrome P450-mediated activity and has been used as an anesthetic. Rat brain microsomes contain 0.07 nmol P450/mg of protein. TCE metabolism by rat brain microsomes at a TCE headspace concentration of 1000 ppm was 45 nm/min/mg of protein at 3 minutes at 37°C. Chloroform, a widely used volatile anesthetic potentiated TCE metabolism to 146 nm/min/mg of protein representing a 321% increase in metabolism. In the presence of the following pregnane steroids at 10^{-6} M: isopregnanolone, pregnanolone and epipregnanolone inhibited chloroform enhancement of TCE uptake by 32%, 27% and 18% respectively. TCE and chloroform were identified using gas chromatography. Temporal resolution and retention time of both compounds were affected by an increase in oven temperature (120°C) thus reducing data acquisition time by 60%. The present study suggests that brain metabolism of TCE is enhanced by chloroform and reduced by pregnane steroids.

Prediction of the Performance of a
Proposed Hydrogen Disposition System
Using a Well-Stirred Reactor Model

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Abstract

Arnold Engineering Development Center (AEDC) wants to initiate ground test capability of hydrogen-fueled aeropropulsion systems in the Aeropropulsion Systems Test Facility (ASTF) using a free-jet test configuration. Such testing will potentially produce combustible mixtures of hydrogen and air entering the exhaust ducting, which represents serious safety considerations. Reduction of the level of hydrogen in the exhaust ducting to below flammability limits requires a Hydrogen Disposition System (HDS). AEDC is investigating the technical feasibility of an HDS for ASTF that involves controlled burning of the exhaust gas using piloted, vee-gutter flameholders. Due to deficiencies in the literature and the hydrogen-air flammability database, AEDC has initiated a technology development program to investigate the flammability limits of premixed, turbulent hydrogen-air flows over the proposed HDS hardware for the range of flow conditions in ASTF where flammability is uncertain.

To predict the flame stability performance of the proposed HDS hardware, the author modeled the recirculation zone of the vee-gutter flameholder as a well-stirred reactor. The well-stirred reactor is a one-dimensional model for steady, homogeneous combustion. Application of the conservation equations and the chemical kinetics of hydrogen-air combustion resulted in a set of non-linear, algebraic equations that were solved numerically using the Lewis General Chemical Kinetics and Sensitivity Analysis Code, LSENS. The flame stability limits predicted by LSENS will be compared to DeZubay's experimental database of hydrogen flammability limits and to the HDS technology development database when testing is complete. Results of the comparison of the analytical predictions and the experimental data will be reported when the analysis is concluded.

Application of the Volterra Functional Series Approach for Understanding Control of Flow Separation Downstream of a Pitching Airfoil

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Washington State University

and

Wyatt O. Davis
Graduate Student

Abstract

A combination experimental/numerical investigation of flow separation for a static airfoil has been conducted using Higher-Order Spectral Analysis (HOS) and the Volterra functional series approach. Input and output time series were recorded downstream of the airfoil at certain points in the flow to investigate and quantize the natural energy transfer mechanisms present. Time series were recorded for two angles of attack, and hot-film anemometers were used to record input and output flow velocities downstream from the airfoil at various fractions of the chord length downstream. Linear and quadratic transfer functions were calculated for these trajectories. These functions were then examined for evidence of natural energy transfer mechanisms in the flow.

Following this analysis of the unforced flow, a study was conducted using pulsed air as a mechanism for control of flow separation. Linear and quadratic transfer functions were calculated for these test cases, and insights were obtained on the mechanism by which the angle of incipient flow separation is increased.

Alan DeVilbiss's report not available at time of publication.

Two-Dimensional Finite Element Analysis of Laminated Composite Plates Containing Distributed Piezoelectric Actuators and Sensors

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Abstract

A finite element formulation is developed to model the response of laminated composite plates containing distributed piezoceramic actuators and sensors. The equations of motion are derived using the variational principle with respect to the total structural and electrical potential energy. These equations of motion are converted to a two-dimensional finite element equation using a First Order Shear Deformation Laminated Plate Theory. The finite element equation is based on the QUAD4 isoparametric quadrilateral element which is currently used in such FEA codes as COSMIC/NASTRAN and ASTROS. This new piezoelectric finite element formulation will be incorporated into an FEA computer code and verified by comparison with published experimental results.

SIMULATION TECHNIQUES FOR PRESSURE AND TEMPERATURE DISTORTION

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Abstract

This is a presentation of simulation techniques utilized to generate pressure and temperature distortion in ground gas turbine engine test facilities. It reveals what is currently available for generating pressure and temperature distortion, ramps, and transients. It also reveals some operational problems, advantages, and disadvantages associated with each simulator. It mentions that as a result from this work, new concepts were conceived for producing pressure and temperature distortion. These concepts were developed to possibly improve upon what was already available in the Arnold Engineering Development Center gas turbine engine test cells and other ground gas turbine engine test facilities. It also mentions that this work is the result of a continuing effort at Virginia Polytechnic Institute and State University to investigate axial flow fan and compressor response to unsteady pressure and temperature distortion and combined pressure and temperature distortion.

PROTOTYPING A MODELING AND SIMULATION INFORMATION NETWORK

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Abstract

The growing amount of information made available through advances in computer technology has created a need for systems that streamline information and make it easy to access. This paper discusses the design of such a system for computer modeling and simulation. Called a modeling and simulation information network, the system brings together information, tools, and technology within a simple interface. The design of the information network, which can be extended to other fields as well, is discussed in terms of a prototyping environment.

PART ONE

DETECTION OF *Ureaplasma urealyticum* IN CLINICAL SAMPLES BY POLYMERASE CHAIN REACTION DNA AMPLIFICATION

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Abstract

Ureaplasma urealyticum has been found to be associated with a variety of diseases in humans, adults, infants, and neonates. A DNA probe which is specific for a particular target DNA sequence unique to this bacteria has been developed (Brogan et al. 1991). This study details the use of this highly sensitive diagnostic technique in correctly determining the presence and absence of *U. urealyticum* in 75 clinical samples.

TEMPERATURE EFFECTS ON AQUEOUS POLYMER AND BIOPLOLYMER SOLUTION VISCOSITIES, ERYTHROCYTE SEDIMENTATION RATES AND CELL VOLUMES IN MAMMALIAN BLOOD.

Professor W. Drost-Hansen

ABSTRACT

In spite of continued, extensive clinical use (especially overseas) , the dynamics and mechanism of the Erythrocyte Sedimentation Rate (ESR) remain poorly understood. As in previous years we have concentrated on elucidating some of the factors affecting the ESR through studies of the effects of temperature on the sedimentation process. In this connection we have extended the range of temperatures investigated to include far lower temperatures than previously considered: data are now available for many species down to about 8 ^{o}C. For the higher temperatures it appears that the dramatic changes with temperature seen near 45 ^{o}C in the ESR and Mean Cell Volumes (RBC) reflect changes in the structure of the interfacial water (the vicinal water) of the systems. For the ESR (and possibly for the MCV)we propose that the anomalous responses to temperature near 45 ^{o}C are most likely effected through the action of the vicinal water on the structural integrity of the spectrin molecule. Similarly, the effects of temperature on the rheological properties of aq. solutions of Polyvinyl pyrrolidone, Polyethylene oxide, Dextran, Bovine Serum Albumin (BSA), Fibrinogen and Cytochrome-c are intimately tied to the vicinal water of hydration of these polymers; thus, more or less dramatic changes in viscosity of such solutions are seen at (or very near) the "Drost-Hansen thermal transition temperatures," $[T_k]$, (for instance, near 15, 30 and 45 ^{o}C.) Similar transitions are seen in the viscosities of blood plasma from a number of mammalian species. In view of the ubiquitous nature of vicinal water it is hardly surprising that nearly all cell-physiological parameters - including osmotic and rheological aspects - vividly demonstrate thermal anomalies at T_k. Most likely, the involvement of vicinal water may explain many previously poorly understood aspects of the ESR while at the same time no doubt further complicating the kinetic picture of this process - for instance due to a distinct shear rate dependence [and hysteresis] of the nature and extent of the vicinal water. Finally, the thermodynamic properties of the intracellular water are also affected by the presence of the vicinal water; thus, the observed , anomalous cell volume changes with temperature (of both erythrocytes and platelets) reflect the influence of the vicinal water on the osmotic equilibria controlling cell volume regulation.

ACTIVE CONTROL DESIGN FOR THE FJSRL SLEWING PIEZOELECTRIC LAMINATE BEAM

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Abstract

The research performed pertains to the development and testing of synergistic active and passive control designs for the piezoelectric laminate beam experiment at FJSRL. Under the AFOSR 1992 Summer Research Program, a multi-input, multi-output transfer matrix model for a slewing beam system with piezoelectric actuators and sensors, was experimentally verified. The piezoelectric beam system at FJSRL was used for this work.

The transfer functions previously established for piezoelectric laminate beam experiment were used to develop and experimentally validate a simultaneously optimal active and passive damping design for the experimental system. However only the optimal active damping was verified here. A preliminary damping design has already been developed and tested at FJSRL. In this study, IMSC, (Independent Modal Space Control) was used for an optimal active control. An optimal active and passive design synergism has previously been developed. The work reported here supports ongoing the progress of contract #RDL 93-156, toward verification of both the active and passive control measures together.

THE DESIGN, DEVELOPMENT, AND PRELIMINARY EVALUATION OF LOADER: A TOOL FOR INVESTIGATING THE ACQUISITION OF CONSOLE-OPERATION SKILL

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Abstract

Console-operation skill is a common requirement of many military and industrial tasks. In an effort to understand and assess the effects of instructional strategies in the acquisition of console-operation skill, the simulation task LOADER was developed. LOADER, a complex problem-solving task requiring the operation of a simulated control-panel console, is analogous to many tasks that call for knowledge of various procedures. The computer-based simulation demonstrates a number of characteristics that make it attractive for the manipulation of instructional strategies within a learning environment. This report details the features and components for use of the simulation tool and provides preliminary descriptive data from a pilot study.

MECHANISMS OF OHMIC CONTACT FORMATION IN
Al-Ge-Ni/n-GaAs CONTACTS

Verlyn Fischer
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Abstract

Gallium arsenide regrowth has been shown to occur in Ni-Ge/n-GaAs contacts by thin film X-ray diffraction measurements before and after heat treatments at 500C. Specific contact resistance, as determined by the transmission line method, was related to the extent of GaAs regrowth. A fully regrown layer produced the smallest ohmic contact resistance and occured when the Ni:Ge ratio was 1:1.

Design of an Apparatus to Measure Particle Size and Carbon Deposition in Thermally Stressed Hydrocarbon Fuels

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Abstract

WL/POSF has a need to improve current generation jet fuels, and to conduct research that will result in future fuels. This research consists of fundamental experimentation to generate global fuel properties, as well as research to determine specific properties of fuels currently in use. One area of fuel property research concerns the deposition process. This study looks at the design of an experimental apparatus to combine photon correlation spectroscopy and the quartz crystal microbalance to analyze the deposition process. Research with this unit will be conducted to determine if there is a correlation between particle size of molecular chains suspended in the fuel and the rate of surface deposition.

A NOVEL APPROACH TO TWO-COLOR PARTICLE-IMAGING VELOCIMETRY

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Abstract

A method of two-color particle-imaging velocimetry (PIV) was developed and demonstrated in a gas phase flow. The technique enables instantaneous imaging of two components of the velocity field using two diffferent-wavelength (i.e. color) lasers and a single two-dimensional detector. The problem of directional ambiguity is resolved by shifting the particle images generated by the two lasers. This shift is introduced in the collection optics by a dichroic mirror and is subtracted off from the computed velocity vectors to obtain actual velocities.

The Rational Design of Novel Semi-Organic Salts for Use as Nonlinear Optical Materials

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Abstract

The primary focus of this project was the rational design of nonlinear optical materials based on the concept of crystal engineering. It was proposed to use hydrogen bonding and π-stacking effects to design NLO optimized organic/inorganic salts. The salt series was based around the imidazolium cation with anions varying in size and hydrogen bonding ability. The salts were screened for second harmonic generation using the powder technique developed by Kurtz and Perry. In addition, the salts were characterized by IR, NMR, Raman, melting point, and mass spectroscopy data.

Gary Gallia's report not available at time of publication.

GUIDELINES FOR USING A TERRAIN BOARD WITH NIGHT VISION GOGGLE TRAINING

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Abstract

Standardized Night Vision Goggle (NVG) training is relatively new in the Air Force. One component of the training typically involves exposure to a terrain board. As of this report, no standardized set of objectives or testing materials have been developed for terrain board training. Subject matter experts were interviewed and terrain board demonstrations were attended in order to gather information on terrain board instruction. From this information, objectives and test items were developed for terrain board training. Based on these objectives, an analysis of the terrain board as an instructional medium relative to NVG training requirements was conducted and recommendations were made for enhancements to existing terrain boards.

Design of an Aluminum Combustion Simulator

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Abstract

This research presents the design of a combustion device which will simulate the aspects of aluminum particle combustion inside a solid rocket motor. At the same time this combustor will allow optical data to be collected during the combustion process.

The first step in this combustor design was to examine past experiments and methods which have been used to examine the combustion of aluminum particles. Next, the fuels and oxidizers, which will be used in the first planned combustion experiments, were selected. The flame temperatures and transport properties of these fuels and oxidizers were calculated using a version of a NASA chemical equilibrium code. The third step in this combustor design was to define the physical dimensions and maximum operating times which would be allowed. These parameters were defined through simplified stress analysis and heat transfer calculations, respectively. The final steps in this combustor design process were to define the procedures and instrumentation to be used during the operation of this combustor.

TWO ISSUES RELATED TO PERSONNEL SELECTION AND PLACEMENT: PERCEIVED ABILITIES AND BIODATA

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Abstract

The development and improvement of personnel selection and placement measures is a constant concern both in the Air Force and in private industry. There remain many unresolved issues in this area concerning the relationships among such variables as perceived and actual abilities, interests, biodata, and the development of personality. Two simultaneous research programs related to these concerns are described in this paper. Study 1 involved an investigation into subjects' capacities to assess their own knowledge and ability level in a variety of topics. Study 2 examined the correlations among biodata items and present personality structure. Subjects were 273 male Air Force basic trainees. Results from both studies involved low to moderate correlations interpreted as promising, but not sufficiently so as to merit full reliance on such methods in an employment setting. Instead, it is suggested that the two selection techniques under investigation here are perhaps best used as a means of gathering supplementary information on prospective employees.

CUE VALIDITY MANIPULATION IN A LOCATION CUING TASK: SHARING VERSUS SWITCHING ATTENTION

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Abstract

A location-precuing experiment was conducted that examined accuracy of target discrimination as a function of varying the percentage of valid cues. A central, symbolic cue was used, with validity percentages of 80%, 50%, and 20%. Results indicated that observers allocated attentional resources according to the percentage of valid cues. A model is presented which provides different predictions for (1) switching models in which the choice of a single area to be preferentially processed is varied over trials, and (2) sharing models in which control is exerted over relative amounts of attention allocated to cued and noncued locations. The data for one observer support the sharing model, and the data for another observer do not discriminate between the two models.

DATA ACQUISITION AND CONTROL OF CRYOGENIC COOLERS DURING EXTENDED LIFE TESTING

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Abstract

The Space Thermal Technologies Branch (PL/VTPT) has undertaken a life performance testing laboratory for cryogenic refrigeration studies and associated efforts. The overall vision includes the development of a state-of-the-art cryogenic refrigeration database to demonstrate reliable and predictable behavior, identify and predict failure modes, and evaluate long term performance changes while making statistical inferences over extended life periods.

To successfully automate initial performance and endurance characterizations of cryogenic coolers, a complete data acquisition and control environment is being designed and evaluated. This capability represents a critically enabling achievement in terms of monitor and control. Using LabVIEW graphical programming for instrumentation, virtual instruments can be developed to completely monitor and control transient response characteristics of long-life coolers during a planned five year study. While acquiring data, the virtual instruments will evaluate and independently control the testing process via standardized instrumentation and cabling.

To date, several successful LabVIEW instruments have been developed and are currently undergoing preliminary testing and monitoring capabilities. Initial data acquisition and control instrumentation includes programs for ultra-low temperature chillers, ion-vacuum turbo pumps, cryogenic sensors, and temperature controllers. The computer emulates these instruments through panels which can be designed to look and function exactly like their "real world" counterparts with two exceptions -- LabVIEW graphics and analysis can be performed in "real time" during testing.

Virtual instruments provide a unique opportunity to completely autotomize the testing process. Essentially, they provide a graphical icon-based capability to replace existing acquisition instruments and control devices. By using analog to digital I/O boards and accompanying peripherals, LabVIEW is considerably more powerful than any of its acquisition predecessor.

FIRE SUPPRESSION TEST CELL (FSTC) APPLICATIONS FOR HALON 1211 AND 1301 REPLACEMENT

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Abstract

The Fire Suppression Test Cell (FSTC) is designed and fabricated for the purpose of testing fire suppression agents, techniques, and systems for implementation in Air Force facilities. The FSTC is being constructed under the supervision of the University of Florida (UF) under contract with the Applied Research Associates (ARA). This joint research initiative is producing a highly mobile "brilliant" structure maintaining the ability to analyze ozone depleting Halon 1211 and 1301 replacements using simulated delivery systems and extensive automation. This innovative project will rapidly assess potential Halon replacements, further reducing retrofit expenses to existing structures and ultimately revolutionizing fire detection and suppression technology.

The FSTC concept is anticipated to provide critical data on the complete spectrum of advanced streaming agents as cost effective, environmentally sensitive replacements for ozone depleting Halon 1211 and 1301. The FSTC will maintain the required long-term flexibility for analyzing future fire suppression techniques and clean air combustion technology.

"Full" Vs. Minimalist Computer Documentation:
A Common-Sense Approach

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ABSTRACT

Creating the user documentation is one of the major tasks involved in any software development project. Notwithstanding, or perhaps because of, the amount of effort that goes into this written documentation, many new users still feel overwhelmed by the large reference manuals. One solution to this problem became apparent during the training session for the high school teachers from across the nation who are taking part in the testing of Armstrong Laboratory's new intelligent reading and writing tutor, *R-WISE (Reading and Writing in a Supportive Environment)*. At the end of the training session, the teachers were surveyed to find out which manual would be most helpful for both themselves and their students, either a full or a condensed version. Reactions were highly mixed, with several teachers recommending that both a long and short version be available. This concept can be further tested with the production of the written documentation for HRT's Science Tutor, which is currently under development.

IMPLEMENTATION OF A NEAR-INFRARED ARRAY CAMERA
FOR SPECKLE IMAGING

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Abstract

The near-infrared camera from Infrared Laboratories was acquired for use on the 1.5 meter telescope at Starfire Optical Range. Ultimately, the camera will be used for speckle imaging of satellites. Normally, detectors using the 1.5-meter are located in a coud´e room or in the imaging lab. For infrared detection, however, the camera must be on or near the telescope since the many mirrors and lenses required to pipe light into a neighboring building allow very little infrared radiation to be transmitted. Due to the size of the camera dewar, a mount was constructed for the camera on the telescope. Testing of the camera and electronics proved successful. It is clear that all mirror optics must be used in the future for optimal transmission. Methods for reducing the data once it is acquired still need to be perfected.

Partial Demineralization of Canine Mandibular Cortices

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Abstract

Partial demineralization is a technique used to process cortical bone alloimplants. Obtaining consistency in this procedure while maintaining a prescribed level of mechanical strength is the chief concern of this protocol. The canine mandible model was used in this study due to its cancellous property and application to mandibular reconstuction. Bone segments were demineralized with 0.6N HCl over a range of time to determine an appropriate time to attain a level of 23%-60% demineralization. A time of approximately 3½ hours was established. A new set of samples were later demineralized in 3½ hours to analyze for relative consistency. 92% of the segments achieved partial demineralization within a range of 23%-60%. Despite a linear relation with time and degree of demineralization, several other variables exist which may influence this process.

A STUDY OF NEURAL GRAFTS ON MEMORY

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United States Air Force

ABSTRACT

The feasibility of neural transplantation used to enhance memory was studied. In this paper, only the staining and slicing techniques of the experiment were detailed. A microtome was used to slice the paraffin-embedded brain and the Luxol-fast Blue stains were used.

Single Crystal 6H Silicon Carbide studied using

Temperature Dependent Hall and Optical Absorption

by

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Abstract

The refinement of Silicon Carbide as a semiconductor will allow for the development of high-power, high-temperature solid state devices. Along this vein, the properties of single crystal 6H SiC grown by several companies were evaluated using temperature dependent Hall effect and optical absorption. The optical absorption experiments yielded information related to the bound excitons in SiC, Vanadium inter band absorption, and another unknown element absorption. On the basis of the slope of the temperature dependent Hall data, the activation energies of the impurities could be discerned, which led to the chemical identification of Nitrogen, Boron, Aluminum, and potentially another unknown element as common impurities in this set of samples.

Mohanjit Jolly's report not available at time of publication.

A FAST ATM ROUTING ALGORITHM FOR THE DYNAMIC THEATER ENVIRONMENT

Claud K. Jones

and

Robert R. Henry
Professor

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University of Southwestern Louisiana

ABSTRACT

Traditional tactical and theater military communication networks are characterized by relatively low bandwidth links. The environment is dynamic in the sense that the links are subject to jamming and the nodes to destruction by the enemy. Modern and future military equipment and tactics require the use of wideband links to exchange bandwidth-intensive information such as video and images. However, current and proposed wideband networks such as ATM have been designed for peacetime, i.e. well-behaved operation. The research described herein proposes and develops an original Fast ATM Routing (FAR) protocol which adapts wideband ATM networks for operation in the dynamic theater environment. It is shown that the FAR protocol provides robust performance in such an environment.

CALCULATION OF ATMOSPHERIC COOLING RATES USING MODTRAN2

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Abstract

A technique for calculating atmospheric cooling rates has been developed based on infrared radiance calculations using MODTRAN2. Comparisons with benchmark line-by-line calculations show very good agreement. The technique provides significant computational time savings associated with band models vs. line-by-line calculations.

AUGMENTING ADAPTATION AND NATURAL SELECTION IN MILITARY AVIATORS

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Abstract

The tendency towards the restriction of biological diversity in aviators is an attempt by the United States military to create a rational process for selecting individuals with the highest potential for battlefield success. A major objective is to use Darwinian selection advantageously, by first understanding the human and machine performance characteristics that lead to battlefield success. Two areas have emerged as areas where improvements may enhance aviator survivability and performance; enhanced prescreening of aviator cardiovascular performance and the development of "smart systems" for biological countermeasures.

Cannon's homeostasis suggests a constancy of the internal environment. Yet, homeostasis is a matter of perspective. It is obvious that maintaining oxygen delivery to the brain is important. Yet to maintain this many other systems are altered along the production-delivery-consumption complex. For instance, the lungs may increase frequency and depth of breathing and the heart may beat faster. Thus, the constant environments of these two are altered.

Thus, the understanding of physiological response to +Gz can not be discussed in terms of homeostasis alone. Therefore LeChateliers principle is important. LeChateliers states that a system in equilibrium will adjust to minimize the effect of an applied force. This gives a unique perspective when considering the response to +Gz. We can view the systemic physiological responses in an n- dimensional state space. A certain trajectory will be traced in this space over time while the system is in equilibrium. When perfusion is altered, there needs to be a compensation. Thus, the organism searches for the best new solution to maintain a new equilibrium with the altered variables. If it is assumed that the system is ordered and not random, then it can tentatively be concluded that some individuals with high +Gz tolerance employ a better search algorithm or that the search can be artificially manipulated.

The purpose of this paper is to explore the analysis of biological signals in aviators with the goal of eventually predicting +Gz tolerance and modeling the physiological response to elevated +Gz.

William Kvasnak's report not available at time of publication.

A Study of Delamination of Graphite - Epoxy Panels Due to Impact with 1/2" Diameter Steel Spheres

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Abstract

Carbon graphite - epoxy composite panels that had been impacted with 1/2" steel spheres at velocities from 399 feet/sec to 5981 feet/sec were studied. After soaking the damaged region in a dye solution, the laminates were pyrolyzed and deplied to reveal the ply-by-ply area of delamination. Delamination and hole areas were quantified and are presented on a per-ply and velocity basis.

AN EFFICIENT METHOD AND CODE FOR DETERMINING TE AND TM PROPAGATION CONSTANTS OF MODES OF INFINITE ARRAYS OF PRINTED ANTENNAS ON DIELECTRIC SHEETS

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Abstract

This report presents an efficient method for finding the roots, TM and TE mode propagation constants for a periodic array of semi-infinite dielectric slabs backed by a ground plane. An adjustable step-searching method combined with a Newton-Raphson procedure gives very reliable and accurate results even for large dielectric thickness or permittivites. CPU time required for finding the roots is reduced considerably in comparison with the work in [1]. Results are presented for various thicknesses and permittivities of the substrate, as well as scan angles and frequencies, and are validated graphically.

PREVENTION OF MAGNETIC INDUCTIVE STORE LEAKAGE PAST A QUASI-STATICALLY COMPRESSED COMPACT TORUS

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Department of Aeronautical & Astronautical Engineering

The Ohio State University

Abstract

A one-dimensional (1D) analytic model was used in conjunction with a two-dimensional (2D) model to study conditions under which inductively stored magnetic energy leaks past a Quasi-Statically Compressed (QSC) Compact Toroid (CT) in the MARAUDER (Magnetically Acclerated Rings to Achieve Ultrahigh Directed Energy and Radiation) experiment. This phenomenon has is called "blowby". QSC means to slowly compress a CT in order to prevent elongation and high inductive impedances. By hypothesis, blowby may be prevented by keeping the ratio of piston field to CT self-field, α, greater than 0.35 but less than unity. The 1D model either assumes α constant or a function of time only, and does not take into effect CT compressibility. This model calculates a current waveform compatible with ideal magnetohydrodynamics (MHD) for use as a driver current in the 2D model. All 2D simulations were accomplished using MACH2, a 2D Arbitrary Lagrangian Eulerian (ALE) MHD code. The 1D α-constant model provided a sinusoidal waveform with a moderate risetime compatible with the idea of QSC, however blowby occurred in many of the associated 2D simulations. This is may be due to inappropriate values of α chosen (0.60 - 0.80) and developing Rayleigh-Taylor instabilities. The single time dependant α case studied did not exhibit blowby, but also did not comform to QSC. In general, the 2D trajectories did not compare well with their predicted 1D trajectories, for either α case, because of severe blowby. The 1D model was discovered to be ill-posed for the α-constant studies since it is impossible for the CT to be in an initial equilibrium state, as assumed in the 2D models. However, the 1D model does provide a waveform that, with the appropriate initial conditions, can be matched by the Shiva Star capacitor bank to provide a starting point for QSC experiments.

High Speed Optical Detectors for Monolithic Millimeter Wave Integrated Circuits

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ABSTRACT

Metal-semiconductor-metal photo diodes with interdigitated Schottky barrier fingers are being developed for applications in monolithic optical receiver circuits with the purpose of detecting millimeter wave modulation signals being transmitted via an optical carrier. The devices are planar and incorporate submicron finger spacings and a thin absorption region for speed with a buried stack of tuned Bragg reflectors for enhanced sensitivity at the carrier wavelength. These devices are being integrated with short-gate MODFET amplifiers to form the complete monolithic integrated optical receiver circuit.

GIS SIMULATION OF TARGET BACKGROUNDS FOR ACT/EOS USING LANDSAT TM AND DTED

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Abstract

A methodology for deriving satellite based input parameters to satisfy the target contrast background model (TCM2) was developed using digital image processing and geographic information systems (GIS). Visible and thermal bands of Landsat TM data and digital terrain elevation data (DTED) were used to characterize growing condition and, to some extent, initial surface soil moisture for a 1-dimensional foliage model using an energy balance solution for solving the temperature of the composite background (foliage and ground). The raster-based GIS, Geographic Resources Analysis Support System (GRASS), served as a platform for the 3-dimensional analysis of thermal and visible bands of Landsat TM draped over a terrain model generated from DTED data. The resulting imagery will provide useful input for the infrared electro-optical tactical decision aid (IR EOTDA) models.

An Ergonomic Study
of
Aircraft Sheetmetal Work

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ABSTRACT

Ergonomic risk factors of aircraft sheetmetal tasks were studied at Kelly Air Force Base in San Antonio, Texas. It was observed that most of the tasks performed by the workers involved fairly high risk of developing cumulative trauma disorders (CTDs) of the upper limbs. An ergonomic screening questionnaire filled out by workers indicated a prevalence of mild forms of CTDs among 77% of the workers. Control measures were recommended to reduce progress and/or development of CTDs; a training program in basic Ergonomics was also suggested as a means to make workers aware of CTD and increase adherence to recommended improvements in work methods. When implemented, the recommended control measures will have a positive effect on sheetmetal worker health and help to reduce future compensation claims associated with CTDs.

INFLUENCE OF PENETRATOR AND TARGET PROPERTIES ON PENETRATION MECHANICS

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Abstract

A previously developed quasi-steady wave mechanics model for penetration of structural targets is modified to include an improved model for the initial and terminal transients. The improved model is then utilized in the parametric study of the influence of penetrator and target properties on penetration depth. The wave mechanics model not only predicts the trends in penetration with variation in these properties, but it also delineates the kinematic mechanisms that are responsible for these trends. It is shown that the combination of high penetrator strength and low target strength produces a local maximum in the plot of penetration depth versus impact velocity. The wave mechanics model shows that the observed decrease in penetration depth with increasing impact velocity is due to flow initiation in the high strength penetrator. For high strength targets, the strength of the penetrator is shown to have little influence on penetration depth. However, for low strength targets, increased penetration results from increased penetrator strength. The effect of penetrator L/D on the ratio of penetration depth to original penetrator length is shown to be very pronounced for L/D's less than 6 but diminishing to near insignificance for L/D's greater than 12. The wave mechanics model shows that the L/D effect is due entirely to the initial and terminal transients. The effects of target strength, penetrator strength, and penetrator density on penetration depth into concrete targets is also presented.

ION-MOLECULE REACTIONS AT HIGH TEMPERATURES

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Abstract

A High Temperature Flowing Afterglow was utilized in the study of ion-molecule reactions. Reaction rate coefficients were measured for the following reactions in the temperature range 300-1300 K: $O^- + H_2$, D_2, and CH_4; $O_2^+ + CH_4$.

The system performance was evaluated in terms of changes needed to effect a more durable and reliable instrument. The effects of the high temperatures and cycling to room temperature dictate further design modifications that will be the subject of another paper (in preparation)[1].

Jane Messerschmitt's report not available at time of publication.

ABSOLUTE OPTICAL SPECTROSCOPY OF METAL VAPORS
ADDING ALUMINUM TO PREVIOUSLY-CHARACTERIZED CHEMICAL SYSTEMS

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Abstract

The optical properties of high-temperature aluminum vapors were modelled using an established theoretical and computational framework, in conjunction with attempts to measure light absorption in these samples with the Plasma Spectroscopy Cell. In addition, the most promising physical conditions and the spectroscopic region most likely to reveal the presence of the hitherto unobserved molecule, LiAl, were established. In this pursuit, experimental and theoretical energy levels and vapor pressures were used to characterize the densities of atomic lithium and aluminum, diatomic homonuclear lithium and aluminum, and the heteronuclear lithium aluminum molecule expected under a variety of conditions. Also, calculated molecular transition dipole moments allowed the absorption due to bound-bound and bound-free processes in the homonuclear diatomics to be added to the atomic contributions in order to provide the background spectrum upon which LiAl might be observed. Specifically, diatomic aluminum is predicted to yield a weak but distinctively-structured band profile and to interfere little with the search for the LiAl molecule among the strong absorption bands of atomic and diatomic lithium and atomic aluminum.

Using Scanning Electron Microscopy for Fiber Analysis

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Abstract

The air asbestos analysis laboratory at Brooks Air Force Base requires a method for identifying the composition of incoming fibrous material. Using morphology and the elemental composition of the sample obtained utilizing an Amray Electron Microscopy 1820 equipped with a Tracor Northern X-ray Analyzer II, it is possible to determine whether an air sample contains asbestos, fibrous non-asbestos or other minerals. The standards and unknown data was obtained by the author using SEM-EDXA technique to establish a reference library for the identification programs and check the analyses process under real conditions. In all, over ninety minerals have been analyzed by the SEM-EXDA as standards and statistical processed to determine the mean and first deviation. To enhance the productivity of the asbestos laboratory, computer programs has been written by the author's mentor. To rapidly accomplish this work, the programs allows the identification of asbestos, high calcium containing minerals, high silicon containing minerals and miscellaneous materials. Analyses of unknown fibers were nearly 100% during the preliminaries review of the procedure.

A MODEL BASED PROGRAMMING ENVIRONMENT FOR PARALLEL IMAGE PROCESSING

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Abstract

This report presents the results of the 1993 Graduate Summer Research Program. The eventual goal of this continued research project is to create a high performance, model–based parallel image processing system with a graphical modeling environment. The main components needed to implement such a system are a modeling paradigm (language), a graphical model building environment, a model interpreter, a parallel run–time environment, and an image processing application library.

Parallel Processing Modeling Language (PPML) and the PPML interpreter provide a modeling environment that is adequate for modeling image processing algorithms. Khoros, a widely used image and signal processing system, contains a graphical programming environment that serves well as a graphical model building environment. Khoros also provides a large, well developed library of image processing algorithms. Since the run–time performance of Khoros is not adequate, though, we chose to use Multigraph as the execution environment. Multigraph is a parallel system integration tool developed at Vanderbilt University that allows the building of complex algorithms from simpler processing blocks. By using the image processing libraries and graphical programming environment of Khoros in conjunction with the IPDL modeling paradigm and the Multigraph parallel execution environment, we have created an image processing system that has the run–time performance of Multigraph as well as the rich image processing library and graphical programming environment of Khoros. The system has been tested for a large variety of algorithms and data–flows, and is considered a success.

Whistler Waves and Ionospheric Particle Precipication

by

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Submitted to the AFOSR
on September 28, 1993, as the summary report of the
Summer Research Program

Abstract

A summary of the various phenomena leading up to ionospheric particle precipication is presented. Lightning discharges emit VLF electro magnetic waves that propagate in all directions. The VLF waves are reflected at the ionosphere where a small fraction penetrate into the plasma beyond and are converted into whistler waves. The magnetized ionosphere guides the whistler waves into the radiation belts where they interact with high energy particles created by the solar wind. These particles are pitch angle scattered into the loss cone created by the Earth's dipole magnetic field and precipitate toward the Earch along the magnetic field lines that guided the VLF waves. Upon reaching the lower ionosphere - or upper atmosphere - they collide with neutral particles and create intense plasma patches.

Experiments performed at Arecibo regarding particle precipitation will then be presented. Analysis of data recovered from the Fall 1992 campaign will be discussed. Preliminary results indicate that modification of the ionosphere by HF heaters may enhance the particle precipitation events.

Chandra Nagaraja's report not available at time of publication.

DESIGN OF AN INTEGRATED WAVEGUIDE OPTICAL PARAMETRIC OSCILLATOR

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Abstract

The theoretical design of an integrated waveguide Optical Parametric Oscillator has been performed. The device will be made of Aluminum Gallium Arsenide which allows the widespread growth and processing knowledge of this material to be utilized. The results of a number of computer simulations are presented and it is shown that it should be possible to build such a device without extreme material growth or processing requirements. The effective index approximation is used for planar and channel waveguide analysis and a brief outline of the requirements for parametric oscillation is given. The outline of a photolithographic mask for device processing is presented.

Synchronization of Chaos Using Proportional Feedback: The Case of a Diode Resonator

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(July 20, 1993)

Abstract

We have demonstrated experimentally a proportional feedback algorithm for the synchronization of chaotic time signals generated from a pair of independent diode resonator circuits. Synchronization was easily obtained and occurred for relative feedback levels between three and eight percent of the driving voltage. Once established, the synchronization persisted throughout the whole range of the resonator bifurcation diagram without varying the gain of the feedback.

A STUDY OF MOS CONTROLLED THYRISTOR (MCT) DRIVER

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Abstract

The MOS Controlled Thyristor (MCT) driver II Integrated circuit, originally designed to gate P-MCT's is also able to gate other MOS devices, both N and P types. It is a single monolithic multi-function circuit designed to drive large capacitive loads at high slew rates. The device is optimized for driving several parallel connected MOS gates, with a total capacitance of $60nF$. At this load level the Gate Driver II achieves rise time of $< 200nS$ and fall time of $< 300nS$. The output provides $+/-$ voltage on the power device gate up to a total voltage swing of 35V.

This experiment is to design an external circuit for MOS Controlled Thyristor (MCT) driver II. The $24VDC$ power supply will be use as a input voltage. The test result will be the output squarewave of the $+12V$ for turn-ON and the $-12V$ for turn-OFF.

GENERAL – PURPOSE ELECTROMAGNETIC MODELING OF COPLANAR WAVEGUIDE STRUCTURES IN MICROWAVE AND MILLIMETER – WAVE PACKAGES

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ABSTRACT

Coplanar transmission lines and coplanar waveguide (CPW) discontinuities have been analyzed by the finite–difference time–domain (FDTD) method. The FDTD computational mesh is truncated by imposing absorbing boundary conditions on the walls, thus simulating outgoing waves appropriate to an open structure. The residual reflection from these boundaries introduces significant error in the frequency–domain parameters derived by Fourier transformation of the time–domain voltages and currents calculated by FDTD at appropriate reference planes. In this research, we have developed a new computationally–efficient method called the geometry rearrangement technique (GRT) to cancel the dominant contribution to the residual reflection from absorbing boundaries. We have applied the GRT to compute the effective dielectric constant of coplanar lines as a function of frequency, and the computed results have been found to be in good agreement with published data, thus indicating the effectiveness of the GRT in canceling residual reflection from absorbing boundaries. We have developed a computer program to calculate the S–parameters of CPW discontinuities. As a test case, we have computed the S–parameters of a coplanar line with an air–bridge, and the results are in excellent agreement with measurements reported elsewhere. We are continuing to validate our program by investigation of other CPW discontinuities such as L–bend with air–bridges and/or dielectric overlay, open-circuited stub, etc. This research is applicable to efficient characterization of MMIC elements and discontinuities, and high–density microwave and millimeter–wave packages, which are currently being investigated in aerospace research. We conclude the report with a summary of potential aerospace–related problems which can be solved with the tools developed in this research.

ANALOG SIGNAL CHARACTERIZATION CIRCUIT

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Abstract

An analog signal characterizer is one that will take is an analog signal and characterize it apart from other signals. The circuit consists of three main modules, each giving a different characteristic of the signal. Three modules were used instead of just one, to better characterize the signal. The analog approach, as opposed to the digital was taken in this case, because the timing of the analog circuit was much faster than the digital. The circuitry used in creating an analog signal characterizer was designed, tested and debugged until a working circuit was obtained.

DEVELOPMENT OF A POLYMERASE CHAIN REACTION ASSAY FOR *UREAPLASMA DIVERSUM*

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Abstract

A polymerase chain reaction (PCR) assay has been developed for the detection of *Ureaplasma diversum* DNA in bovine clinical samples. The assay uses oligonucleotide primers, derived from a DNA sequence unique to *Ureaplasma diversum* to generate a discrete product or amplicon. Hybridization studies enabled the definition of the unique fragment and partial sequencing of the segment led to the selection of primers. The PCR based assay is highly specific and sensitive for *U. diversum*. This technique lends itself well to a clinical laboratory setting since it can be performed on crude lysates of samples within six hours. *Ureaplasma diversum* pathogenesis is not well understood and once this assay is established and used regularly, it could help define this microorganism's exact role in the disease state.

Ureaplasma urealyticum, a human pathogen closely related to *U. diversum*, was also studied this summer. It is another poorly understood organism and various experiments were done in an attempt to characterize its etiologic and pathogenic roles in neonatal disease.

PCR Detection of Mycoplasma hominis in Clinical Samples

Study of a DNA Probe for Escherichia coli Strain 0157:H7

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PCR Detection of Mycoplasma hominis:

Abstract: Mycoplasma hominis was detected in clinical samples by means of a Polymerase Chain Reaction based assay. The detection resulted from the generation of a 152 base pair PCR product which represented a fraction of a 471 base pair Mycoplasma hominis genomic DNA segment. The PCR based assay was developed during last summer's AFOSR program by a colleague who is currently enrolled in a M.D./Ph.D. program at Thomas Jefferson University. My task was to test the specificity of the PCR assay by compiling data using clinical samples supplied in various types of transport media.

INVESTIGATION OF ARCJET-POWER PROCESSING UNIT INTERACTION: EMISSION RIPPLE VELOCIMETRY I

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Abstract

The behavior of the arcjet space thruster plume was studied using the emission ripple velocimetry method whereby the gas plume is observed to be radiating in conjunction with the change in power-processing-unit current levels as a function of time. The diagnostic method itself is investigated as is the experimental setup required for the measurements. In addition, appropriate data acquisition software was written. The effects of the high-frequency (16 kHz) 17% peak to peak current ripple of the PPU on the plume emission is examined and found to be 30-50% ripple peak to peak. This modulation of the emission is found to convect with the plume and lead to a velocity diagnostic method whereby the convection of the emission ripple leads to a velocity determination when the ripple phase is extracted as a function of position. As this method is examined it is found that the accuracy of the technique degrades as measurements are taken farther downstream from the nozzle. Modifications to the measurement technique are suggested and will be implemented should further funding accommodate such work.

AN ARTIFICIAL NEURAL NETWORK APPROACH TO STRUCTURAL DAMAGE DETECTION USING FREQUENCY RESPONSE FUNCTIONS

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Abstract

Structural damage detection in a twenty-bay planar truss was accomplished using an artificial neural network. Instead of using natural frequencies and mode shapes, the frequency response functions (FRF's) experimentally obtained from accelerometers at two locations on the truss were directly used to distinguish among damage cases and to train the network. Unlike conventional approaches based on system identification techniques, the neural network approach does not require an analytical model of the structure. The direct use of the FRF's eliminates the need for modal parameter identification. Out of the 60 damage cases considered in this study, the neural network was able to identify uniquely 21 damage cases and narrowed 38 others down to two possible damaged struts.

Optical Properties of $Al_xGa_{1-x}As/Al_yGa_{1-y}As$ Quantum Wells Grown by Molecular Beam Epitaxy Using Desorption Mass Spectrometry for Composition Control.

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Abstract

We report the ability to produce high optical quality $Al_xGa_{1-x}As/Al_yGa_{1-y}As$ quantum well structures by molecular beam epitaxy (MBE) using the in-situ sensor technique of desorption mass spectrometry (DMS) for composition control. Growth takes place at elevated substrate temperatures for which the Ga incorporation efficiency is significantly below unity. Under constant incident Ga and Al fluxes, there is a one to one correspondence between composition and Ga desorption rate $F_d(Ga)$. Continuous composition control is achieved by controlling the measured value of $F_d(Ga)$ to that required to achieve the desired composition, via feedback of the desorption error signal to the arsenic source valve. A decrease in incident arsenic flux $F_i(As_2)$ causes an increase in $F_d(Ga)$. In order to examine the ability of DMS-control to provide rapid and controllable composition variations, two (2) nominally identical $Al_xGa_{1-x}As/Al_yGa_{1-y}As$ square quantum well structures were grown using: 1) conventional composition control, and 2) $F_i(As_2)$/DMS-control. The structures were characterized by low temperature photoluminescence (PL) and room temperature photoreflectance (PR) spectroscopy. Excitonic transitions were observed only in the quantum well of the DMS control structure.This structure had a high PL efficiency and a narrow line width.

QUANTUM WIRE STRUCTURES GROWN BY MOLECULAR BEAM EPITAXY

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Abstract

Arrays of $In_{.20}Ga_{.80}As/GaAs$ quantum wires were fabricated using electron beam lithography, reactive ion etching and citric acid etching, wet chemical surface preparation, *in situ* annealing, desorption, migration enhanced epitaxy, and molecular beam epitaxy. The wires were examined by photoluminescence (PL) and transmission electron microscopy (TEM). TEM photographs show that the wires have smooth interfaces and excellent sidewall coverage with no visible dislocations or defects. The successful regrowth was achieved only after development of the combination of reactive ion etching and wet chemical preparation of the wafers. Arrays of 190nm wires exhibited a PL efficiency of 24% compared to the unpatterned quantum well and a 11.1meV shift of the luminescence to higher energy, which may partially be due to increased quantum confinement. The largest part of the shift is likely due to defects incorporated on the wire surfaces during the patterning process. The relatively high efficiencies make the quantum wires candidates for embedding in an optical cavity to form quantum wire lasers.

EVALUATION OF NETWORK TOPOLOGY IN A DISTRIBUTED PROCESSING ENVIRONMENT

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Abstract

The impact of network topology on the performance of a distributed processing environment was evaluated through experimentation and simulation. Experimental runs of the JDL experiment on Cronus were used to collect traffic data for use in determining the limitations of Ethernet-based networks. Discrete-event simulation and analytical modeling were used to estimate the performance of heavily-loaded Ethernet and FDDI networks.

Polarization Considerations for Optical Correlators

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Abstract

The effect on polarization errors on the performance of optical correlators is examined. These errors are examined in the example of a matched-filter correlator with spatial light modulators which are nominally amplitude-only modulators. The modulators consist of a retarder oriented at 45° with spatially varying magnitude followed by a polarizer at either 0° or 90°. Three errors are considered - 1) misorientation of the input polarization state, misorientation of the polarizer, and nonlinear eigenpolarizations for the retarder. The first error is shown to reduce the height of the correlation peak. The second error is shown to reduce the height of the correlation peak and increase the background noise. The Third error has no effect. Following the discussion of polarization errors in optical correlators is a broad discussion of polarization analysis of optical systems. This discussion presents the underlying theory of the preceding section.

ANALOG TO DIGITAL CONVERSION METHODOLOGY AND DOCUMENTATION, DATA ACQUISITION / CALIBRATION SOFTWARE

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Abstract

A methodology for analog to digital (A/D) conversion and subsequent data analysis of cardiovascular hemodynamic data was developed. Specifically, documentation and computer software were written to support the conversion process.

Two forms of documentation were developed. First, a "how to" manual describing in detail the operation of the hardware and software used in the data conversion process was written. Second, a series of A/D records were created to support, document and simplify the conversion process. These records describe all hardware and software settings that effect the final digital output, the location of the digital output, calibration information, dates and study names, signal names and numbers, and signal quality comments.

Computer software was written to: 1) import raw binary data, 2) aid in calibrating the data, 3) display the data, and 4) automatically pick individual heart beats. These routines are accessible through a user-friendly user interface.

AN ITERATIVE METHOD FOR COMPUTING THE SCATTERED ELECTRIC FIELDS AT THE APERTURES OF LARGE PERFECTLY CONDUCTING CAVITIES

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Abstract

An iterative method is developed for computing the scattered electric fields at the apertures of large perfectly conducting cavities. The technique uses Kirckhoff's approximation to initiate a two stage iterative process, involving both the magnetic field integral equation (MFIE) and the electric field integral equation (EFIE), to calculate the electric currents on the internal cavity walls and the electric fields across the aperture of the cavity. The technique combines the flexibility of the boundary-integral method with the speed necessary to efficiently analyze large scale cavity problems. The following paper presents the general theory, and applies the technique to the problem of TE scattering from 2-dimensional perfectly conducting cavities.

DEVELOPMENT OF NON-INVASIVE PROTOCOLS FOR INVESTIGATING TROPHODYNAMICS OF DASYATID STINGRAYS IN ST. ANDREW SOUND

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Abstract

Dasyatid stingrays in St. Andrew Sound were studied over a 10 week period from 21 June - 28 August 93. Non-invasive methods were utilized in the removal of stomach contents from collected specimens. Rays were captured by one of three methods; otter trawl, casting net, and dip net. Capture by otter trawl was the most abusive collection method utilized. The casting net proved to be the least injurious method of collection. Four species of rays were collected: the Atlantic stingray, *Dasyatis sabina*, the southern stingray, *Dasyatis americana*, the roughtail stingray, *Dasyatis centroura*, and the smooth butterfly ray, *Gymnura micrura*. The spotted eagle ray, *Aeteobatus narinari* and the cownose ray, *Rhinoptera bonasus* were observed in the sound. *D. sabina* was the most common ray found, and was most often seen on sand flats either searching for food or lying on the bottom covered with sand. A method of gastric lavage was utilized in the removal of stomach contents from live rays after rays were anesthetized with MS-222. A 60 cc syringe was connected to a salem sump tube (stomach tube), filled with sea water, lubricated, and inserted through the mouth into the stomach. Water was rapidly pumped in and out of the stomach by pushing in and pulling out on the plunger of the syringe. A slurry of food and water was created in the stomach allowing food items to be effectively removed. Rays were revived and released uninjured. Several rays held in holding tanks for long term evaluation of this procedure were seen feeding on shrimp within one hour of the procedure being performed. On preliminary evaluation stomach samples were found to contain polychaetes, mysids, grass shrimp, and larval fish. These findings suggest that dasyatid stingrays are opportunistic feeders. Stomachs were removed from 13 *D. sabinas* for evaluation of this method. Forty-four percent of these stomachs were empty. Fifty-five percent of the stomachs contained some food items, and with one exception, no new food types were found.

MULTIMODAL MEASURES OF MENTAL WORKLOAD DURING COMPLEX TASK PERFORMANCE

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Abstract

Central and autonomic nervous system measures of mental workload were examine concurrently during tasks that varied in their perceptual/central and physical demands. A cognitive arithmetic and continuous manual tracking task were performed singly and together. The perceptual/central demand of the cognitive arithmetic task was manipulated by varying the number of addition and subtraction operations required to solve a problem. The physical demand of a single-axis, second-order compensatory tracking task was manipulated by varying the amount of force operators had to apply to the joystick. Multiple psychophysiological responses were recorded during task performance including: electroencephalographic, cardiovascular, pulmonary, and eye blink measures. Data will be collected from twenty-four subjects, but only preliminary analyses on a subset of responses from selected subjects are available at this time.

DELAMINATION DAMAGE AND ENERGY EXCHANGE FROM PENETRATING IMPACT OF SPIRAL STAIRCASE LAYUP COMPOSITE PLATES

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ABSTRACT

The change in delamination damage and energy exchange due to impact of composite plate (graphite/epoxy) was studied, using spiral staircase layup. The 4 different layups are

A) $[(0/90)_8]_s$, B) $[(0/+45/90/-45)_4]_s$,

C) $[(0/+22.5/+45/+67.5/90/-67.5/-45/-22.5)_2]_s$, and

D) $[(0/+11.25/+22.5/+33.75/+45/+56.25/+67.5/+78.75/90/-78.75/-67.5/-56.25/-45/-33.75/-22.5/-11.25)]_s$, impacted with a 1/2 inch steel sphere at a low and high velocities.

ELASTANCE RATIOS FOR OPTIMAL VENTRICULO-ARTERIAL COUPLING

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Abstract

Computer programs were developed to utilize and verify equations from Ewert, et. al. (1992), which were used to estimate total peripheral resistance and arterial compliance under transient gravitational conditions. These equations along with an equation to estimate the optimal ratio of arterial elastance to left ventricular elastance for maximal external work transfer were then used to analyze high +Gz and micro-gravity data. Preliminary results indicate that the heart and arterial system are at times maximally coupled; however, under most cases, it seems that the two are not. In fact, the trend of the experimental elastance ratio seems to be opposite the trend of the calculated optimal elastance ratio.

HEAT TRANSFER ASPECTS OF SUPERCRITICAL FUELS

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Abstract

Approximately twenty years ago military aircraft began using fuel as a coolant. Today, fuel is the primary coolant for many aircraft subsystems such as engine, hydraulics, and environmental control. Fuels for then next generation of high speed aircraft will need to absorb a significantly increased heat load. Increasing heat loads will eventually push the fuel into the supercritical range. The supercritical heat transfer mechanism is not fully understood. The Air Force has a long term goal of obtaining a feasible fuel which can be heated into the supercritical range. This study looks into that possibility.

USING A NEGOTIATION SUPPORT SYSTEM TO INTEGRATE INTERESTS

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Abstract

The current study used a variable-sum negotiation task to determine the degree to which computer-assisted dyads are better than manually assisted and unassisted dyads at achieving integrative bargaining agreements. Male and female dyads engaged in both a four-issue and an eight-issue negotiation during a single experimental session. While computer assistance did not improve performance for females, computer assisted males obtained a significantly higher proportion of the integrative total on the four-issue task than did unassisted and manually assisted males. In addition, while computer assistance did not appear to improve interest estimation, significant positive correlations were obtained between estimation accuracy and the outcome measure for both tasks.

A STUDY OF TIRE CARCASS FATIGUE FAILURE DUE TO PURE MECHANICAL DEGRADATION

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Abstract

Isothermal fatigue studies were performed on tire carcass coupons. Results were compared to studies performed without temperature control for the determination of the relative contributions of mechanical and thermal fatigue. As expected, coupon lifetime without thermal effects was greater than with thermal effects. It was found that at low stress values material properties like tan δ were primarily dependent on temperature effects, while at higher stress values, these properties were more dependent on mechanical effects. This was due to lack of damage caused by mechanical fatigue at lower stresses, leading to longer lifetime and therefore more time for chemical changes.

Evaluation of an Approach to Intelligent Coaching with Student Modeling

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ABSTRACT

The purpose of this study was to investigate if students learn *better* with on-line *intelligent coaching systems* driven by student modelling than with *passive on-line help systems*?

Most of the research effort in ITS was centered around investigating the implementational issues involved in constructing components and systems. The field has now reached a consensus on the different types of ITS systems, and their respective components. Therefore, it is important to begin evaluating the effectiveness of intelligent coaching systems to alternatives such as passive on-line help systems.

Relevant research is very sparse. Mark and Greer (1991) compared the education impact of several coaching systems to one another. The results indicated that students who learned with intelligent coaching that incorporates student modelling and knowledgeable feedback used fewer steps and had fewer errors when doing their task.

The purpose of this experiment is to investigate if Students learn *better* with on-line *intelligent coaching systems* driven by student modeling than with *intelligent coaching system without student modeling* or *passive on-line help systems*? The experimental study that investigated the question posed by research was conducted at the USAF Armstrong Laboratories. The results demonstrate students who used the coaching system with student

Kimball Shahrokhi's report not available at time of publication.

CONTACT LAW FOR LOW-VELOCITY IMPACT OF COMPOSITE MATERIALS

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ABSTRACT

Low-velocity impact damage is a critical consideration in the design of composite laminates for aircraft structures. Composite materials offer high stiffness and strength at a significant weight savings over metals. Low-velocity impact damage is a particularly insidious problem because it is difficult to detect by visual inspection. These impacts occur during the course of normal flight and maintenance operations and often leave only a small, shallow dent on the impact surface. But there may be significant interior and backface damage to the laminate. In order to design composite materials for impact tolerance, it is necessary to develop methods to model composite structures and simulate the loads. A contact law describes the relationship between the indentation of an impacting object into the target and the transmitted force. A modified Hertzian theory is commonly used. This model requires experimental data and only predicts the total force as a function of indentation. For more accurate determination of the stresses which cause impact damage, a contact law which predicts the distribution of force in the contact area is necessary.

CRYSTAL STRUCTURE OF CHOLESTERYL-4-VINYLBENZOATE

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Abstract

The structure of cholesteryl-4-vinylbenzoate was determined by X-ray diffraction. The molecule is elongated, with the benzoate group oriented out of the plane of the tetracyclic core. Molecules pack anti-parallel, with overlap between either aliphatic tails or tetracyclic cores. These two types of interactions (overlap) are similar to the two packing modes that co-exist in the liquid crystalline phase.

A STUDY OF THE ROLE OF NITRIC OXIDE IN MILLIMETER WAVE INDUCED CIRCULATORY SHOCK

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Abstract

The purpose of this study was to investigate the possible involvement of nitric oxide (NO) in Millimeter Wave induced shock. Because most animal studies of shock use the anesthetic pentobarbital, it was first necessary to determine if the ketamine model used in this study was valid. To do this, dose-response curves of mean arterial pressure (MAP) and heart rate (HR) were plotted. It was shown that there was no significant difference between the two anesthetics. Furthermore, L-NAME showed a dose dependent increase in the both groups of rats. With this area secure, we used our ketamine model to study the effects of the NO inhibitor L-NAME in both irradiated (shocked) and non-irradiated (normotensive) rats. It was shown that L-NAME caused an increase in mean arterial pressure (MAP) in both groups, however, the effect was smaller in the shocked rats.

DESIGN AND TEST OF A DIGITAL CROSSBAR SWITCH FOR TMS320C40 DIGITAL SIGNAL PROCESSORS

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ABSTRACT

A digital crossbar/crosspoint (Xbar) switch has been designed for the communication ports (commports) of the Texas Instruments TMS320C40 Digital Signal Processor (DSP). The Xbar switch allows any one of eight commports attached to the switch to communicate with any of the other seven commports, with a maximum of four connections in the switch at a time. The crosspoint switch allows any one port to broadcast data to as many of the other seven ports as desired. This Xbar design was reviewed, laid out on a printed circuit board, built, and the crossbar part of the switch tested during the 1993 AFOSR summer research tour. This report discusses the design of the switch and the software routines used to test and control the switch. These software routines form the basis for a complete Xbar switch control software package. The feasibility of using this switch in a TMS320C40 parallel processing system is demonstrated by these tests.

OPTICAL INTERCONNECTS

Robert Spencer

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ABSTRACT

Research en rs this mmer in conjunction with the AFOSR summer research program followed two courses - chemically d ion bam etching (CAIBE) of compressively strained layer quantum well lasers and the design and fabricati lymer waveguides for in- plane and plane-to-plane optical signal distribution. The mission of the grou h I was assigned at Photonics Laboratory of Rome Laboratory is the design of optical interconnect schem anced computer architectures. As signal processing speed, power dissipation requirements, and ize requirements become more severe for new-generation Air Force electronic systems new concepts in ution must be evaluated. Optical signal distribution networks for wafer scale integration and dule packing schemes are being examined by the photonics lab. In current VLSI systems, the RC ciated with electrical interconnects are limiting the overall signal processing speed and are therefo eneck in a variety of novel computing architectures. Optical interconnects are limited ainly by mat de dispersion and the bandwidth of the sources that are used for the optical signal. state ctors have bandwidths that are several times larger than the bandwidths of optical ces and ar rently limiting processing speed, although the efficiency of optical detectors is still a antial con eving low power dissipation optical interconnects. I therefore examined two aspects of optical inter - compressively strained quantum well lasers for optical sources and polymer waveguides. ained quantum well lasers have demonstrated the highest directly modulated bandwidth to d any semiconductor laser while polymer waveguides offer processing compatibility with both GaAs chemical, mechanical and thermal stability, and excellent optical properties. A better understanding of and waveguides is necessary to completely realize fully optical interconnection schemes that will design and fabrication of advanced computer architectures that are required by the Air Force.

$Cr:Al_2O_3$ THIN FILMS AS OPTICAL WAVEGUIDES AND AMPLIFIERS

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ABSTRACT

The purpose of this project was to evaluate the potential for developing thin film waveguide materials from nontraditional glasses. In the initial phase, completed this summer, Al_2O_3 was investigated. The dependence of the optical properties, refractive index and loss, were examined as a function of the processing conditions. The nonequilibrium nature of reactive rf magnetron sputtering was found to allow deposition of amorphous Al_2O_3 films within a wide processing window. Both x-ray and electron diffraction verified that the films were amorphous in the as-deposited state for substrate temperatures up to 500°C and for a wide range of oxygen flow rates. These films had excellent optical and mechanical properties, with an average refractive index of 1.65 at 500nm, optical losses of 1-4 dB/cm throughout the visible, transmission windows that extend well into the infrared, and they are hard, chemically-stable, wear-resistant, and adherent. Both refractive index and loss were found to be dependent on processing conditions. The refractive index was found to increase with substrate temperature, but to be independent of oxygen flow rate. The loss, however, was sensitive to oxygen flow rate.

As a final check on the amorphous structure, Cr-doped films were prepared by co-depostion. No fluorescence was detected in the amorphous films. Annealing the films at 1000°C yielded crystalline γ-Al_2O_3 films that demonstrated weak fluorescence. Annealing at 1200°C produced α-Al_2O_3 films that exhibited the strong characteristic fluorescence of ruby. The results of this study demonstrated the feasibility of producing thin film waveguides with good optical properties from oxides which are not traditional glass formers, and suggests that materials which serve as good rare-earth hosts (Y_2O_3, YAG) warrant further investigation.

ANALYTICAL GUIDANCE LAWS FOR HOMING MISSILES

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ABSTRACT

In this study polar coordinates are used to obtain an analytical guidance law for homing missiles. The closed form solution for the guidance law is developed using modern control techniques. To develop this control scheme, the dynamic equations of the target-intercept problem are decoupled. The decoupling of the radial and transverse coordinates is accomplished by introducing a pseudo-control in the radial direction. The commanded acceleration in the radial direction is determined through the use of pseudo-control and the commanded acceleration in the transverse direction is determined from the solution to a two-point boundary value problem. The two-point boundary value problem is solved through the use of the state transition matrix of the intercept dynamics. The optimal guidance law is also used to compare the solutions for other guidance laws such as True Proportional Navigation (TPN) and Ideal Proportional Navigation (IPN).

A SELF-TUNING PIEZOELECTRIC VIBRATION ABSORBER

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Abstract

A self-tuning piezoelectric vibration absorber is presented. This device, similar to a mechanical vibration absorber, has to be tuned to a particular structural vibration mode in order to be effective. The absorber presented here will tune itself to a particular mode and track that mode if it varies in frequency. A set of experiments were designed and conducted to demonstrate the self-tuning absorber. A cantilevered beam was used as the base structure with its second mode as the target frequency for the absorber. Design of the absorber consisted of a pair of lead zirconate titanate (PZT) tiles on the structure shunted by an inductor-resistor circuit. This produced an electrical resonance that could be tuned to the desired structural mode. The performance criterion for the absorber was determined from a ratio of the RMS response of the absorber to the RMS response of the structure. A simple control system was designed using only the change in slope of the RMS ratio as criteria to increase or decrease the electrical resonance of the shunt. Experiments using coarse, fine, and a combination of frequency step-sizes are presented. Finally, the response of the absorber to an abrupt change in system parameters is also examined.

Transmission of VLF Waves into Ionospheric Ducts at Arecibo, Puerto Rico

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Abstract

The coupling of monochromatic VLF waves into the ionosphere is discussed. The specific problem of 28.5 kHz transmissions from NAU, the Navy communications transmitter in Puerto Rico, entering artificially-induced ducts over Arecibo is studied. Detailed consideration is given to index of refraction, transmission coefficients, group velocity, and energy flow. Computations are performed for the case at hand as a rough approximation of the coupled power.

A NOTE ON THE EXISTENCE OF RACIAL BIAS IN SUPERVISORY RATINGS OF JOB PERFORMANCE

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ABSTRACT

Recent research on the effects of race on ratings of job performance has focused on the question of whether or not Black and White supervisors rate members of their own race more favorably than members of another race. In general, these studies have found that both Black and White supervisors tend to rate Whites higher than Blacks. While this finding is notable, it fails to adequately address more fundamental questions regarding the existence and nature of racial bias in supervisory ratings. A reexamination of the data from these studies revealed that (a) both Black and White raters reported a mean group performance difference favoring Whites, (b) Black and White supervisors did not agree on the magnitude of this difference, and (c) the difference between Black and White supervisory ratings of White ratees appeared negligible, while the difference between Black and White supervisory ratings of Black ratees was quite large, suggesting that racial bias occurred in the rating of Black job performance. Implications of these findings for differential validity and prediction is discussed.

FEASIBILITY INVESTIGATION OF IN-HOUSE EDGE EMITTING SEMICONDUCTOR LASER FACET COATINGS

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The feasibility of reactive ion sputtering for deposition of high reflectivity dielectric stacks has been investigated. Two dielectric material systems were attempted; SiO_2/Si and Al_2O_3/Si. The specific laser material system was an InGaAs/GaAs/AlGaAs quantum well layer structure operating at about .92 um (Pseudomorphic InGaAs quantum well with GaAs optical guiding layers). During the course of the work, it was determined that cross contamination was occurring in the sputtering chamber between dielectric sputtering depositions and metal sputtering depositions performed for other projects. This contamination showed up in the form of absorbing dielectric layers and peeling metal layers. It was found that a moderate cleaning and pre-sputtering decontamination scheme was not sufficient to eliminate the contamination problems. An alternate reflector scheme utilizing a more basic Al/Si_3N_4 metal/insulator configuration (Si_3N_4 deposited by Chemical Vapor Deposition) was studied and fabrication was initiated. These coatings should theoretically yield reflectivities of up to 90% (vs. 35% for uncoated GaAs). Finally, MathCAD documents were developed to optimize multilayer designs, and to model ellipsometric measurements of the refractory coatings for extraction of optical constants and thicknesses.

INTRODUCTION

Although edge emitting lasers may often lase quite well without reflective end facet coatings, performance may be substantially enhanced by the addition of this relatively low cost step. In addition to passivation of facets (protection of surfaces from the elements during high temperature operation), high wavelength selectivity reflectance coatings offer lower threshold currents (scales linearly with reflectance of each facet) and higher mode locking thresholds. Mode locking threshold is the measure of the spectral purity of the optical output vs. power. Passivation of end facets is especially important for higher power operation, since there is usually significant facet absorption loss and catastrophic optical damage associated with uncoated facets. All this boils down to a faster, higher temperature, and more efficient laser. The purpose of this work was to determine if laser facet coatings could be performed with equipment currently available at the WL/ELRD WPAFB, Dayton, Ohio clean room facility.

Thermal Modeling of Beam Heating of Solids

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Abstract

Two methods for calculating the temperature rise in a crystalline (thermally isotropic) solid due to heating from a laser beam or other kind of beam, such as electrons or protons, are discussed. The first method uses an equation that is evaluated numerically. The second method described is the modeling of the solid and the way it is heated using the finite element code ANSYS. Tables and graphs are presented, and the two methods are compared regarding their advantages and disadvantages. The models may be effective in helping to determine the heating effects of radiation on crystals used in electronic, optical, and acousto-optic devices.

PROPOSED STUDY OF HYPERBARIC OXYGENATION INFLUENCE ON HEPATIC CYTOCHROME P-450 MICROSOMAL ENZYME SYSTEM IN THE MALE SPRAGUE-DAWLEY RAT

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ABSTRACT

Hyperbaric oxygenation is currently used by many in the medical community as a standard treatment for various disorders, but there is little information on the subject of hyperbaric oxygenation and drug metabolism. This proposed study will link basic scientific data and suggest new experiments that will further define and validate the role of hyperbaric oxygenation and provide information so other areas of applications, such as novel drug delivery and xenobiotic detoxification, can be investigated.

The main goal of this proposed study is to systematically study the relationship between hyperbaric oxygenation and cytochrome p-450 hepatic microsomal enzyme system in the male Sprague-Dawley rat. Three model drugs antipyrine, quinidine, and acetaminophen would be used to identify changes in the hepatic monooxygenase enzyme system. Data could be gathered from this study that would provide a mechanistic understanding of drug metabolism in a hyperoxic environment.

DETERMINATION OF THE REDOX CAPACITY OF SOIL SEDIMENT BY SPECTROELECTROCHEMICAL COULOMETRIC TITRATION

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and
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Abstract

The oxidative redox capacity was determined for size-fractionated soil sediment samples by the method of spectroelectrochemical coulometric titration. This method involves the measurement of absorbance of sediment particle slurries at the wavelength absorption maxima of the optically detectable mediator-titrant (reporter) molecules resorufin and methyl viologen as a function of the charge passed in a constant-potential coulometric titration. Titrations were carried out on diluted samples of gravitationally sedimented particle fractions containing particles smaller than 2 micrometers average diameter. The fraction containing particles of size < 2 micrometers was 0.115 % by weight of the initial sample slurry, which was 4.3 % solids by weight. The total organic content of the < 2 micromenter solids was 3.5 % organic carbon by weight. Titration was carried out at a diluted sediment particle concentration of 0.0128 % by weight. Resorufin was reduced first, followed by an irreversibly reducible sediment component which was consistently observed to titrate between resorufin and methyl viologen, and finally methyl viologen. The reducible component, which was absent from titration blanks, was not reoxidized when the methyl viologen and resorufin were electrochemically reoxidized. The sediment fraction studied had an oxidative redox capacity of 15 $\pm$ 2.5 millicoulombs, corresponding to 0.65 milliequivalents per gram of sediment. The heterogeneity of the original sample was evidenced by the observation that the whole sediment slurry became reducing, whereas the fractionated < 2 micrometer particle slurry remained oxidizing.

TRYPTAMINE AS A DERIVATISING AGENT FOR THE ANALYSIS OF ISOCYANATES IN SPRAY PAINTING OPERATIONS

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Abstract

Tryptamine was used as a derivatising reagent for the analysis of airborne hexamethylene diisocyanate (HDI) in monomeric and polymeric forms, using high performance liquid chromatography with flourescence detection. Also, the use of solid sorbent tubes in actual field operations was compared directly to the results obtained from impingers.

ARTIFICIAL NEURAL NETWORK INVESTIGATION IN AUTO SOURCE UPDATE PROGRAM

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Abstract

An investigation of artificial neural networks (ANN) in the candidate selection of auto source update (ASU) program was conducted. Among many types of ANNs the emphasis was given to the probabilistic neural network (PNN) architecture. As compared to other types of ANNs, PNN has proved to be reliable and superior in terms of speed of operation and simplicity of adaptation process. A PNN network was designed and implemented to find the best match and its confidence estimate for a given message among several possible candidates. Different experiments were conducted on a set of messages and candidates from the Defense Mapping Agency (DMA) databases to check the performance of the PNN. The results have been successful and promising. Future enhancement of the proposed PNN and other ANN methodologies in ASU program has also been presented.

Local Environment Effects on Evaporation Rates of Flowing Droplets

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Abstract

The local environment is observed to have an effect on the evaporation rates of flowing micrometer-sized droplets. A 9-orifice droplet generator is used to produce 9 droplet streams arranged in a 3 x 3 square array. Droplet evaporation rates are deduced from spectroscopic droplet size change measurements. Ethanol and ethanol/acetone droplets are doped to a concentration of 5×10^{-5} M Rhodamine 6-G laser dye. With illumination by the 532 nm second harmonic Nd:YAG laser pulse, the droplets can reach the lasing threshold because the droplets act as optical cavities, supporting discrete wavelengths which corresponding to Morphology-Dependent Resonances (MDR's) of the droplets. The difference in size among the droplets can be deduced by measuring the wavelength-shift of a particular MDR for successive droplets in the flowing streams. The rate of size change for droplets within a given droplet stream is observed to depend on the stream position within the 3 x 3 array. The center droplet stream exhibits the lowest evaporation rate, the edge droplet stream exhibits more evaporation, and the corner droplet streams exhibit the highest evaporation rate.

HARDWARE IMPLEMENTATION OF ACTIVE JITTER COMPENSATION TECHNIQUE FOR OPTICAL COMMUNICATIONS SYSTEM

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ABSTRACT

An active jitter compensation scheme applicable to free space intersatellite laser communication is developed. The theory, design and implementation of the prototype are discussed. A performance evaluation of the existing unit is presented. The theory and design of a second generation self-tuned prototype is discussed including the concepts of on-line acoustic path modeling, intelligent band-pass filtering, modular system construction and optimization techniques. Finally, a pair of alternate technological approaches applicable to the jitter cancellation concept are presented.

EVALUATION OF AN IMMOBILIZED CELL BIOREACTOR FOR DEGRADATION OF META- AND PARA-NITROBENZOATE

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Abstract

Meta- and para-nitrobenzoic acid (m-NBA, p-NBA) are pollutants found in waste streams from metal-stripping processes utilizing cyanide-free solvents. The Kelly AFB Industrial Waste Treatment Plant (IWTP) is currently incapable of removing these compounds from the waste water it receives because of (1) the presence of significant quantities of ethylenediamine, a preferred substrate, and (2) an upper limit of 4.5 hours on the hydraulic residence time in the IWTP. This work describes the enrichment and preliminary characterization of a microbial consortium capable of utilizing both m-NBA and p-NBA as sole carbon sources. Experimental results indicate that m-NBA degradation involves an oxidation pathway, while p-NBA degradative proceeds through a reductive pathway. This consortium was immobilized by entrapment in alginate beads and grown in a continuous-flow airlift reactor. Single substrate and mixed substrates were fed to the reactor. Conditions were varied to simulate different waste treatment scenarios: switching from one stripping solvent batch to another, starting up of the metal stripping process, mixed solvent batches, and changing the loading rate of substrate to the bioreactor. Results indicate that the nitrobenzoate fraction of the metal stripping waste can be effectively treated in a continuous-flow, immobilized-cell bioreactor with a hydraulic residence time well below 3 hours. Furthermore, the process can be operated over long periods (>250 hours) with little diminution of performance and responds rapidly to changes in substrate.

EFFECT OF TYROSINE SUPPLEMENTATION ON COGNITIVE PERFORMANCE AND FATIGUE IN SLEEP-DEPRIVED HUMANS

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Abstract

This study was designed to examine the effect of tyrosine (TYR) supplementation on fatigue induced decrements in cognitive performance during sleep deprivation. Nine healthy, male subjects participated in two sleep deprivation sessions separated by two weeks. Each subject ingested 75 mg/kg body weight of either TYR or placebo during the TYR session (T) and placebo session (P), respectively. In each session, subjects reported to the laboratory following a full day of work and were tested for 16 hours throughout the night beginning at 1800 h. Each subject completed a cognitive performance battery, subjective fatigue rating and recorded oral temperature hourly. Every other hour a POMS Mood Scale was completed. Intake of energy nutrients was similar for two days prior to the sleep deprivation trials, however mean TYR intake was greater ($p<0.05$) for the two days prior to P (2988.0 ± 942.13 mg) than for the two days prior to T (2085.5 ± 678.09 mg). All fatigue scores and temperature were lowest between 0300 and 0600 h. Cognitive performance was also lowest at this time. Oral temperature was significantly higher ($p=0.02$) for T (36.93 ± 0.330 °C) than for P (36.23 ± 0.414 °C). Subjective fatigue ($p<0.11$) and POMS fatigue ($p<0.06$) each showed a tendency to be less for T than for P. None of the variables analyzed by the cognitive performance battery were different between T and P. While the TYR dosage failed to affect the decline in cognitive performance in this study, future studies utilizing more stressful conditions to increase catecholamine depletion and/or larger doses of TYR would seem to be warranted.

THE EFFECTS OF FRAMING ON HUMAN PERFORMANCE IN A DYNAMICALLY COMPLEX WORK ENVIRONMENT

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Abstract

In order to better understand and integrate developments in man-machine work environments and multi-faceted information technology, the new field of cognitive engineering has emerged from research in the fields of cognitive psychology, computer sciences, and human factors. Our focus is to emphasize the contribution that one sub-area of cognitive psychology, judgment and decision making, can make to cognitive engineering (Nygren,1993). For simple decision contexts, it has been shown that how a choice task is framed to individuals in terms of gains or losses can drastically alter their final judgements and choices (see Kahneman & Tversky, 1979). We propose that such framing effects will consequently have an observable impact on the actual performance of the task as well. To examine this hypothesis, we conducted an initial study of the effects of framing in the dynamically complex work environment of the flight operator. Our results showed that framing does produce an effect on the operator's performance; however, the actual effects and influences of framing in this dynamic decision-making environment appear to be more task specific than in a simple choice task.

GAS CHROMATOGRAPHY ANALYSIS OF PHENOLIC-CARBON COMPOSITE PYROLYSIS

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Abstract

A fundamental step in the processing of carbon-carbon materials is the pyrolysis of cured phenolic-carbon composites. This reaction, which converts the phenolic matrix to one of amorphous carbon, is not well characterized. An understanding of the reaction kinetics could lead to improved processing of carbon-carbon materials. Analysis of the pyrolysis using thermogravimetric analysis and infrared spectroscopy techniques have identified four reaction stages. An investigation of the benefit of using gas chromatography to analyze the gas products of phenolic/carbon composite pyrolysis to further increase the understanding of the reaction kinetics has been made.

ELECTRIC FIELD INDUCED SECOND HARMONIC GENERATION IN GERMANIUM DOPED SILICA PLANAR WAVEGUIDES

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Abstract

Frequency doubling in germanium doped silica planar waveguides deposited on fused silica substrates is studied. It is demonstrated that an externally applied, periodic DC field can cause instantaneous frequency doubling in these waveguides. The periodicity which causes frequency doubling corresponds to the beat length between fundamental and second harmonic light propagating in the waveguide. A current has been measured from these periodic electrodes which corresponds to the generation of a periodic DC field internal to the glass when illuminated with both fundamental and second harmonic light.

A MODEL OF THE SHOULDER, ELBOW, HIP, KNEE AND ANKLE JOINTS FOR THE ARTICULATED TOTAL BODY MODEL PROGRAM

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Abstract

The Articulated Total Body Model program (ATB) is a computer program which has the ability to describe the three dimensional response of a body in different types of dynamic environments. The model contains a series of coefficients and equations, which work together to describe the response of the different segments and joints of a body, when specific loads are applied. In many cases a coefficient is able to describe certain reponse characterisitics quite accurately, however, there are cases when an equation would be much more accurate. As the experimental data becomes available, equations may be derived to be used in place of coefficients. This report explains how experimental data containing the resistant force and resistant torque characteristics of the shoulder, elbow, hip, knee, and ankle was manipulated. The data was manipulated to form characterisitic equations that would be suitable to replace the corresponding coefficients in the ATB program.

MATRIX ELEMENT COMPUTATION USING RECTANGULAR PATCH FIELD COMPUTATION FOR ELECTROMAGNETIC SCATTERING FROM BODIES OF REVOLUTION

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Abstract

Computation of the matrix elements for a method of moments solution to the electric field formulation of electromagnetic scattering from bodies of revolution using rectangular field patch computation is investigated. The rectangular patch method uses a series summation to calculate the electric field due to a small, uniform amplitude, rectangular patch of surface current. Typically, computations of this type have used delta function approximations to ease the computational burden and reduce computer solution time. While the rectangular patch field method is computationally slower and more cumbersome, its use relieves other problems associated with a delta function current approximation.

Synthesis

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Abstract

Modeling and Simulation is an activity that touches all aspects of science. The modeling and Simulation Department at Rome Laboratory developed a vision after a broad survey of the work being done at the four super laboratories of the Air Force Materiel Command (AFMC). One result of this survey was the creation of the first Rome Laboratory database publicly available over the INTERNET. The vision created by the Modeling and Simulation Summer Research Group aided in the development of a dedicated modeling and simulation laboratory. This paper describes these efforts and concludes with an example of how a dedicated modeling and simulation facility can impact the course of research here at Rome Laboratory.

VORTEX DYNAMICS IN PATTERNED SUPERCONDUCTING FILMS

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Abstract

The complex surface impedance $Z_S(\omega,H,T)$ of patterned Nb and $Y_1Ba_2Cu_3O_{7-\delta}$ thin films has been studied by measuring the resonant frequency and quality factor (Q) of suspended self-resonant patterned structures. Measurements have been carried out on various geometries for several resonances below 20 GHz, in fields up to 6 T and for temperatures down to 4.2 K. These experiments provide a sensitive probe of vortex dynamics, and can be used to investigate the vortex transition from pinning to flow, and possibly distinguish between the various theories which describe the transition region. The field dependence at fixed frequency and temperature for $Y_1Ba_2Cu_3O_{7-\delta}$ samples is analyzed in detail and is found to be consistent with a "single vortex" picture. From this data we also extract useful material parameters such as pinning forces and the flux flow viscosity. By comparison with the results on unpatterned films, only a minimal influence of patterning on the sample characteristics is observed.

CAPTURE AND ANALYSIS OF RAT'S 22-KHZ VOCALIZATIONS

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Abstract

Stressful stimuli often elicit 22 kHz ultrasonic vocalizations from rats. Ultrasonic vocalizations emitted by rats in startle chambers were digitally recorded in order to determine if startle-induced stress is manifest in the physical characteristics of these calls. Acoustical analysis of properties of rat ultrasonic calls was begun during the summer at the Armstrong Laboratory (OEDR) and is continuing in the bioacoustics laboratory at the University of Georgia.

Additionally, rhesus macaques (Macaca mulatta) were video taped and their vocalizations were recorded in various housing arrangements. The purpose was to broaden the data base of an on-going study comparing the expression of emotionality and stress in captive versus free-ranging groups of primates. This study is directed toward establishing a method for distinguishing between normal and abnormal levels of emotionality in laboratory

SCATTERING OF DIELECTRIC SPHERES IN DRY TO LOW MOISTURE CONTENT SOILS

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Abstract

The problem of test range cleanup is introduced. A brief discussion of subsurface radar is supplied. Using Stratton's original scattering equations a model is compiled for generating the back-scattering cross section for dielectric spheres (in any media). The backscattering cross section for dielectric spheres of various sizes and dielectrics are shown (in various media). Finally, the system is checked by comparing H.C. Hulst's 1957 tabulated values for a perfect dielectric in free space.

HYPERSPECTRAL IMAGING: FIELD EXPERIMENTS

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Abstract

The application of hyperspectral techniques to the imaging and identification of space objects was investigated during a series of field experiments at the Starfire Optical Range. Prior modeling and simulation efforts indicated that the increased target object information obtainable through hyperspectrometry should significantly enhance the ability to perform Space Object Identification (SOI). During the test series, many satellite targets were acquired and tracked, and data was recorded for subsequent analysis and evolution. The concept of hyperspectrometry is described in general terms, and aspects of the field tests are described. Technical performance of this long-term research is under the direction of Capt. Susan Durham, Ph.D. of the Phillips Laboratory's Imaging Technology Branch (PL/LIMI).

READING AND WRITING IN A SUPPORTIVE ENVIRONMENT (R-WISE)

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ABSTRACT

This report is based on the Reading and Writing in a Supportive Environment (R-WISE) computer program. This program was designed to help tutor ninth graders on their reading and writing skills. This report is going to give you ideas about how the R-WISE program works and looks. R-WISE has eight tools: Freewriting (Dinosaur Drag), Sticky Notes, Writing Pad, Thought Log, Crossword Puzzle, Cubing, Revision, and Idea Board. In addition to describing this software, I will tell you how I helped with the R-WISE program.

How To Establish and Configure a Local Area Network

Stephen A. Antonson

Abstract

Interoffice communication needed to be established to increase productivity. The easiest and most effective way to accomplish this was with a LAN (Local Area Network). A variety of network adapters were used to create a thin Ethernet network among five computers. This network was established and maintained by using Microsoft® Windows for Workgroups™.

Alicia Araiza's report not available at time of publication.

THE BUILDING OF THE USAF PANASONIC UD-809AS ALGORITHM

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Abstract

In an attempt to improve personnel monitoring for neutron emissions, Panasonic has developed the UD-809AS, a thermoluminescent dosimeter (TLD). The UD-809 contains $^{7}Li_2{}^{11}B_4O_7$ as its first element to measure background gamma radiation. The other three elements are composed of $^{6}Li_2{}^{10}B_4O_7$, which is more sensitive to neutron emissions and is relatively gamma insensitive. Elements 1 and 3 are shielded by cadmium on both sides. Elements 2 and 4 are shielded by cadmium and tin. The goal is to develop an algorithm which will utilize the data gathered from the UD-809 to measure exposure to neutron radiation and thereby be able to calculate the dose to the individual wearing the badge. This report is the primary step in developing this algorithm. Three different existing UD-809 neutron algorithms were analyzed. Suggestions are then offered for future action in building a UD-809 algorithm.

COMPUTER AIDED DESIGN
OF ACES-II FLIGHT ESCAPE MODULE

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Abstract

The computer aided design (CAD) of the Advanced Dynamic Anthropomorphic Manikin (ADAM) test dummy was generated for use in Computational Fluid Dynamics (CFD) testing. The CAD drawing of the ACES-II ejection seat was provided by the United States Navy. The ACES-II ejection seat is the current model incorporated in the F-15 and F-16 cockpits. A CAD drawing of the ADAM was needed to perform Computational Fluid Dynamics (CFD) of both the seat and a test dummy during the crew escape sequences. The CAD drawing of the ADAM was made to fulfill the first requirement of the CFD generation.

FIRE PROTECTION

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Tyndall Air Force Base, Florida

Abstract

During the course of eight weeks this summer, I was placed in the DF Directorate, referred to as Fire Protection. Here I was able to become more knowledgable about fire in general by assisting around the office with regular day to day work. I helped along with projects, including fire certification, and the development of tests to allow these firefighters certification. I also helped with manning DF Directorate phones, typing documents, sending faxes, and making copies. I believe that this was an exceptionally good and enlightening experience for me in that I became able to assume an overall better generalized assessment of the'working field.'

THE TRANSPORT OF A FUEL JET IN SUPERSONIC FLOW

Brian J. Banaszak
High School Apprentice
Aero Propulsion and Power Directorate
Tecumseh High School

Abstract

The Wright-Patterson laboratory is currently studying the effects of fuel injection in supersonic flow. To obtain supersonic air speeds, engineers developed a wind tunnel that provides air at specified Mach numbers ranging from 1.5 to 3.0, depending on the nozzle that is in place. Also, a splitter plate was developed in order to inject helium into the supersonic stream. The splitter plate simulates strut injection, one possible method of fuel injection in a scramjet. The test section of the wind tunnel contains windows on 3 sides and there is a window in the diffuser that allows the flow to be sliced in all 3 directional planes. Having this capability will allow concentration measurements of helium, at various locations to be made using acetone PLIF (Planar Laser-Induced Fluorescence). A YAG laser in conjunction with a Wavelength Extender (WEX) was used to generate a sheet of UV (266nm) laser light to pass through the test section causing the acetone to fluoresce. A CCD camera was positioned to take pictures of the fluoresced acetone, thus capturing the helium flow pattern. An excimer laser was used to measure the velocity of the fuel flow through an OH flow- tagging method. These laser diagnostics provide a good reference for future experiments that will use hydrogen instead of helium. The results of the hydrogen combustion will be applied to design a new scramjet engine capable of travelling at hypersonic speeds.

EFFECTS OF CHRONIC +Gz EXPOSURES ON RATS

Jason A. Barber

ABSTRACT

A pilot study of the effects of chronic +Gz exposures on rats was conducted using a Small Animal Centrifuge (SAC). During the six weeks of the study, animals were exposed to either 0.5 +Gz or 22.5 +Gz in either single or multiple exposures. Control animals were not exposed to +Gz. Body weights, food intake and temperatures were recorded on a daily basis. Data collected showed a steady decline in body weights, an increase in body temperatures, and food intake remained at a constant consumption.

ORGANIZATION AND EVALUATION OF FRAGMENT SHATTER TEST DATA RESULTS USING THE MICROSOFT EXCEL SPREADSHEET

Jennifer R. Bautista
High School Apprentice
Computational Mechanics Section, Warheads Branch
Wright Laboratory Armament Directorate
Eglin Air Force Base, Florida

Abstract

During my second summer in the HSAP program, I organized and evaluated fragment shatter test data for over 800 experiments done by NSWC. In order to organize the data, make xy plots, and evaluate discrepancies in the information, I utilized the Microsoft EXCEL spreadsheet. The information was sorted according to specific criteria and put into small groups of similar information, so that engineers in my section will be able to pinpoint particular data points. Once the organization was complete, xy plots of impact velocity versus residual mass and residual velocity were charted, and test shots which appeared to be questionable were identified.

COLOR NEUTRAL RUGATE FILTERS

Jessica M. Behm

ABSTRACT

The description of a transmissive rugate filter designed to reflect a portion of the visible spectrum and yet not appear to have a dominant color. The filter design criteria were chosen so that the filter rejects portions of the visible spectrum from 0.38 to 0.78 microns. Observing a scene through this type of optical filter one perceives it to be color neutral, although it is somewhat darker. The design constraints require a solar light source. The eye bounds the wavelength range over which perceived coloration is affected. For this work the spectral characteristics of both the incident light and the standard human eye determine the spectral tailoring of the reflection bands. Rugate filter design and fabrication technology permits a very wide variety in the number, location, bandwidth, and peak height of all reflection bands. The result is a color neutral rugate filter having reflection bands tailored to provide the human user with maximum color discrimination capability.

Dermal Absorption Rate of
Dibromomethane

Sara Berty
Carroll High School

Abstract

In order to determine the absorption rate of dibromomethane, a physiologically based pharmacokinetic model was developed. Cannulas were inserted in the external jugular vein of anesthesized, male Fischer-344 rats, and after each animals' back had been shaved, a glass exposure cell was affixed with adhesive. The following day, the cells were filled with three milliliters of a dibromomethane in mineral oil dosing solution. Blood samples were drawn through the cannula immediately after dosage and again after ½, 1, 2, 4, 8, 12, and 24 hours. The blood was injected into vials containing one milliliter of hexane; and after the samples had been shaken on a vortex evaporator for 15 minutes, the hexane was drawn off the blood and analyzed on the gas chromatograph. The concentration of dibromomethane in the samples was determined from the area counts provided by the gas chromatograph. These values were then used in the physiologically based pharmacokinetic model to estimate the dermal penetration rate of dibromomethane.

THE POSSIBLE TIME REDUCTION OF CFD SOLUTIONS
RESULTING FROM GRID SEQUENCING

Ryan B. Bond
Student
Tullahoma High School

Abstract

Grid sequencing, a technique used to reduce run times of solutions in computational fluid dynamics, was studied. A technique was developed to determine the time at which the solution should be transferred from one grid to another. The technique produced sequences that were either the fastest sequence or very close to the fastest sequence on multiple flow solvers using inviscid calculations. The method by which data is transferred from one grid to another was also tested. It was found that , for the inviscid calculations, use of the fourth order interpolator and the linear interpolator produced results with insignificant differences in the same number of iterations.

The Presence of Sulfuric Acid in the Stratosphere
and Its Effect on High Altitude Aircraft

Andrea B. Bowlby
Phillips Laboratory/Geophysics Directorate
Hanscom Air Force Base, Massachusetts

Abstract

The effect of sulfuric acid in the stratosphere on high altitude aircraft was studied. After conducting research on the properties of sulfuric acid aerosols and the materials used to construct airframes and engines as well as discussing the topic with meteorologists and aircraft engineers, the data indicated that any impact H_2SO_4 may have on aircraft is negligible. The results of the investigation suggest that sulfuric acid does not cause significant structural damage to a plane nor does it impede performance. Nevertheless, the sulfuric acid content of the stratosphere is a threat to the environment because it has been linked with ozone depletion, climactic changes, and acid rain.

HIGH SCHOOL APPRENTICESHIP PROGRAM FINAL REPORT

1993 WL/FIVEC EXPERIENCES REVIEWED

BY: JASON BRECHT
AUGUST 6, 1993
DISCRETE BASE PAGE NUMBER 12

Many times in my life I have been offered opportunities which enrich both my intelligence and my problem solving skills. This summer, another one of these opportunities presented itself. I applied for and was accepted into the HSAP (High School Apprenticeship Program) at Wright Patterson Air Force Base. Although I did not realize it at the time, my stay on the military base would not only enhance my intelligence, which is one concrete aspect of my knowledge, but would also provide me with a much more practical and well-rounded education. The knowledge which I will take with me from this job will make me a better person, not only in the immediate future, but for the rest of my life.

My official job title was "Data Collection Analyst." I feel it was fortunate that the job description did not directly apply. My first day on the job I met George Kurylowich, my supervisor, and Dave Brown, a man with whom I would be working with very closely for the next two months. Dave introduced me around the office, and almost immediately I felt comfortable. The other office employees all welcomed me and treated me as if I had been there for years. I was now an official member of the Environmental Control Branch of the Flight Dynamics Directorate (FIVEC). I was then taken to see the test site.

DATA ORGANIZATION AND ANALYSIS USING MICROSOFT EXCEL AND WORD, ELECTRO-OPTICAL RESEARCH

C. David Brown

Abstract

This summer I was given the opportunity to work in both a lab and an office during my tour of Phillips Laboratory. In the office I used a Macintosh IIci computer with Microsoft Excel and Word to organize and analyze the results of a laboratory survey, and I designed a spreadsheet to keep track of employees salaries and awards in my directorate. In the lab I assisted in state-of-the-art electro-optical research. The goal of this research was to eliminate the current problems associated with using an antenna for hardness testing on military systems by replacing the antenna with an electro-optical transducer crystal. I have divided the paper into two sections; the first dealing with my work in the office, the second with my laboratory work.

Aaron Cabral's report not available at time of publication

Lisa Camero's report not available at time of publication

INTERPOLATION IN LOAD-PULL MEASUREMENT SYSTEM'S POWER DEVICE CHARACTERIZATION

Nicholas T. Campanile

Beavercreek High School

WL/ELM

Abstract

The primary summer focus was on the analysis of a load amplifier and the measurement of impedance's at various tuner states. Taking actual measurements is a time consuming and inefficient process for the professional world. Therefore, it is necessary to consider that an amount of values is accurate without actually measuring them but by effectively gathering data by interpolation. EEsof's commercial package Anacat allows for such a program to be written while storing the newly created data in recallable files.

PROGRAMMING IN ADA

Jason P. Carranza
VL/AAAP3
Vright-Patterson Air Force Base

ABSTRACT

During the summer of 1993, I participated in the Air Force Office of Scientific Research (AFOSR) High School Apprenticeship Program as an apprentice of Charles B. Hicks at Vright-Patterson Air Force Base. During this time, my main goal was to learn the computer language "Ada". The first half of my summer vas spent learning and reading about "Ada". In order to improve my programming skills, I vrote numerous programs and sections of source code. By the second half of the summer I vas able to vrite full programs, packages, and associated testdrivers vith little outside help. It vas during this time that I finished my project vhich dealt vith improving and completing a project initially started by a former AFOSR student. Using the many advantages of "Ada", I completed the project successfully vithin the allotted time.

Performance Testing of Molecular Sieve Oxygen Generating System at Low Pressure

Shawn P. Carroll
Summer Research Apprentice
Systems Research Branch
Crew Technology Division
Armstrong Laboratory

Abstract

A performance study was conducted on two different high purity oxygen concentrating systems. The study was based on the goal of achieving a 99% or greater oxygen concentration at the most productive flow rate. The first system was constructed according to the design (U.S. Patent # 4,880,443) of a high purity molecular sieve oxygen concentrator. The second system resembled the first in all aspects except that a vacuum pump (Fig. 1) was installed via the exhaust valves. Theory indicated that the vacuum system, once pumped down to a low pressure, would outperform the standard system. Results of the study revealed that the vacuum system did in fact outperform the standard system, but only for half of the test parameters; the standard oxygen concentrator produced more desirable results for the remainder of the test parameters.

Computer "specialists"
among us

Carmen Casares
Clinical Sciences Division
Decision Support Branch
MICAS Computer Systems

ABSTRACT

This world has come to a period where almost everything has been automated. In a sense this can be good. With the proliferation of computers, it is almost impossible to know everything there is to know about them. There is too much to know and remember. In addition, there are too many types of systems, software, and computers.

At Brooks Air Force Base, computers are essential to the everyday work schedule of almost every person on staff. These people are helped by those who excel in computer science. As a team, the knowledge of all these computer "experts" is incredible. Their jobs include duties that range from putting personal computers together to managing databases and large mainframe systems. These people do even the simplest tasks such as restocking a printer with paper. Some of their work can be so involved that it can take weeks before something is wholly completed. Despite the fact that their jobs are often frustrating and demanding, they can be counted on to complete a task promptly and to the best of their ability.

EPIDEMIOLOGY AND ITS MANY ATTRIBUTES

Sabrina A. Cayton
Summer Research Apprentice
Aerospace Medicine
Armstrong Laboratory

Abstract

Epidemiology's effect on scientific research and the field of medicine becomes obvious after learning of its many uses for the detection, prevention, and eradication of numerous human ailments. Through the use of its many descriptive and analytic studies, information can be collected and analyzed for answers to various scientific questions. Research of this kind requires the combined effort of a multitude of individuals that work toward a common goal. This feat involves the use of epidemiology's various studies, which lend themselves to the particular situation that surrounds the disease of interest. The accommodating nature of these studies is: however, slightly tainted by their susceptibility to bias, chance, and the like. The use of epidemiology has led to our vast knowledge of human disease, and it is epidemiology that will be responsible for the continuation of progress in this area.

Sameer Chopra's report not available at time of publication.

COMPUTER AIDED SYSTEMS FOR HUMAN ENGINEERING

Eleanore Chuang

High School Apprentice

ABSTRACT

As a high school summer apprentice in the Human Engineering Division of Armstrong Laboratory at Wright-Patterson Air Force Base, I worked in the DEfTech (Design Effectiveness Technology) Laboratory, testing software to be implemented in the CASHE (Computer Aided Systems Human Engineering) Version 1.0 program. In between software tests, I completed tasks which exposed me to graphics and program development and familiarized numerous hardware items, such as those involved in networking and memory augmentation. During the course of these eight weeks, I have learned a great deal about the importance of human factors engineering in product design. In addition, I have had the privilege of accessing some of the advanced software available for use on the Apple Macintosh family of computers.

ANALYSES OF VARIOUS SAMPLES FOR THE PRESENCE OF METALS

Kara L. Ciomperlik
High School Student
12th Grade
East Central High School

ABSTRACT

The main function of the Metals Section of the Armstrong Laboratory is to provide support for bases worldwide in the analysis of environmental and occupational samples for metal content. These samples include, but are not limited to, drinking water, wastewater, soils, sludges, biologicals, and air samples. The section analyzes an average of 10,000 samples per year with the average of four or five different analyses. The sample load is almost evenly split between occupational and environmental samples. Analysis of the sample is accomplished by using several varieties of spectroscopic instruments including Inductively Coupled Plasma (ICP), Flame Atomic Absorption (FAA), Graphite Furnace Atomic Absorption (GFAA), and hydride generator for the analysis of mercury. This section also manually prepares samples for mercury analysis.

FROM MINDS TO MISSILES:
THE DESIGN, DEVELOPMENT, AND TESTING OF
AERODYNAMIC MODELS

Theresa J. Cook
High School Apprentice
Aerodynamics Branch
Wright Laboratory Armament Directorate

Abstract

The aerodynamic qualities of weapon airframes and munitions can be examined through the use of scale models and analysis of free-flight test data. The different stages of aerodynamic modeling were studied in three different programs: the GBU-28, a precision guided bomb, HAVE DASH II, an air-to-air missile, and the PGU31-B, an armor-piercing munition. The GBU-28 was studied with the Projectile Design Analysis System, while the properties of the HAVE DASH II and the PGU31-B were investigated in the Aeroballistic Research Facility and the Ballistic Experimentation Facility. The data obtained from the finished tests was determined to be accurate, while the work done on ongoing testing has yet to be evaluated. All the results obtained will be used to provide control data for the programs.

THE USE OF THE TRANSCUTANEOUS pO_2/pCO_2 MONITORING SYSTEM IN THE HYPERBARIC CHAMBER

Kathlyn E. Cosgrove

ABSTRACT

Hyperbaric oxygenation is used as a treatment for many different problems, such as acute traumatic ischemias and "bubble trouble." This experiment will be used to find out if the transcutaneous pO_2/pCO_2 monitoring system will help the effectiveness of the hyperbaric chamber. From previous studies it has been found that the transcutaneous pO_2/pCO_2 monitoring system dilates the size of the blood vessels. Under pressure, in the hyperbaric chamber, the size of the blood vessels decreases. If this monitoring system is used in the hyperbaric chamber then there is the possibility that the amount of time spent in the chamber can be decreased.

Oriana Cruz's report not available at time of publication.

Computer Performance
in Function
Decomposition

Kevin M. Dalley

Abstract

The growth rate of run times of function decomposition with a tabular and non-tabular setting using a fixed number of cares was studied. To start with, six random recursive functions were chosen having an input range from 8 to 14 variables with the output of this function being a binary string. Portions of this binary string were then "masked" in two forms, one tabular and the other non-tabular. This masking is done by taking a fixed number of cares from the binary string and leaving the placement of the others in a don't care format where the polarity is not known. Then a computer program attempts to decompose the function into sub-functions and the run time is recorded. After the results were gathered, The non-tabular setting had better performance in low number of cares experiments, while the tabular stayed constant no matter what number of cares were used.

MY EXPERIENCE AS AN RDL SUMMER EMPLOYEE

David J. Danelo

High School Student

MY EXPERIENCE AS AN RDL SUMMER EMPLOYEE

This report, as the title suggests, will detail my experiences as an RDL summer employee. My participation in the High School Apprenticeship Program (HSAP) took a somewhat different turn then I had initially anticipated. When I received the notice that I was chosen to be a summer employee, my impression was that I would be participating in some kind of technical research. In actuality, I have been exposed to various kinds of work -- everything from library tasks to computer maintenance.

I was able to work in this capacity for two main reasons. First, the division I was assigned to, Human Resources Plans & Programs (HRP), is not a research oriented division, so I had little opportunity to participate in any kind of research. Second, my mentor took some time to show me standard office procedures when I first arrived. This was beneficial from the beginning, as it gave me the familiarity with a general worksetting, whereas my peers had to take more time to adjust.

BIODEGRADATION OF SOLID ROCKET PROPELLENTS (NH_4ClO_4)

James E. Davis Jr.
Laboratory Investigator
Environics Directorate
Armstrong Labs

Abstract

Since the U.S Governments focus has shifted from the Arms Race to advocating a new world order, there have been many concerns regarding the environmental consequences arising from years of weapons development. Several components of various weapon systems must now be disposed of, many of which are potentiallly hazardous to humans. These components enter the environment as contaminates in ground water, the atmosphere, or in the soil itself. One such chemical is ammonium perchlorate (NH_4ClO_4); the main component of the solid rocket fuel used in most class 1.3 missles. A microorganism capible of reducing ammonium perchlorate as a food source in combination with brewer's yeast has been isolated. Unfortunatly, brewer's yeast has a high solids content though it provides favorable conditions for the bacteria. Previously, the brewer's yeast nutrient contained large amounts of solids and had to be agitated. This study determined that most of the solids are not necessary for perchlorate reduction to occur in a continuous culture. Two experiments were conducted. One using a well mixed suspension of Brewer's yeast solids at 30g/L and another using only the supernate after 24 hours of acid extraction. Perchlorate degradation rates were calculated for both experiments. The pH, temperature, and agitation were controlled at ~7.1, 40°C, and 200rpm, respectively.

FREQUENCY CONVERTOR REPAIR

Nick DeBrosse

Abstract

The Compressor Research Facility (CRF), located in Wright Patterson Air Force Base, studies and records the behavior of full scale, multistage, single pool, axial flow compressors and small fans. The 44,00 horsepower, 6,900 volt frequency convertor contributes a vital role in CRF's overall operation. If the frequency convertor should malfunction, CRF's compressor testing would be terminated until the frequency convertor would be once again operational. Therefore, proper annual preventive maintenance is mandatory.

INFRARED MEASUREMENTS OF ELECTROMAGNETIC FIELDS

Michael P. Decker

Abstract

This research experiment developed a procedure for relating the temperature distribution on a RF detector to the incident power density. An infrared (IR) measurement technique was used to detect electromagnetic (EM) fields over a two dimensional area. A horn antenna was used to radiate RF energy on a RF detector material. The detector absorbed a small amount of the incident RF energy, causing the surface temperature of the detector to rise above the ambient temperature. The temperature distribution on the detector was measured with an IR measurement system.

CHARACTERIZATION OF SOILS FROM RANGE 22 TO DETERMINE CONTAMINATION

Nancy Deibler

ABSTRACT

Metal contamination in soil is a hazard to the environment. Since munitions testing using a large range of metals have taken place at Range 22 since the early 1940's, there is a possibility of metal contamination in the soils on Range 22. If the level of metal contamination in the soils at Range 22 is known then modification of testing to prevent any further contamination and/or the precise treatment of the soils can be executed to decontaminate the soil. Metal contamination in the soils at Range 22 was investigated. A total of 16 soil samples was taken in selective areas at Range 22. The soil samples were characterized in the chemical laboratory. The soil samples' pH and metal content were determined using instruments in the laboratory. The element of metal, amount of each metal, and the pH of each soil sample was found and compared to controls of similar soil texture for their contamination level. The results show that there is possible iron and aluminum contamination in some soils at Range 22. Further testing, such as, contour analysis and core soil testing will make it possible for conclusions to be drawn on metal contamination of soils at Range 22.

Calibration of a Reactive Ion Etching System

Chris Dodsworth
WL/ELR
Wright-Patterson AFB

Abstract

A calibration of the mass flow controllers in our Reactive Ion Etching system in the cleanroom was performed. The correct flow rates for five different gases at multiple settings was determined and graphed. In addition, the maximum flow rates for the gases was also determined and compared to the previous values. This new data will be helpful to researchers because it will enable them to perform reproducible etches.

I studied circuit design for the remainder of the time. I created and attempted to build a traffic light controller using combinatorial logic. Although the model I built did not work, an analysis of the circuit design showed that the design was correct. I came to the conclusion that some of the circuit components used were bad.

LITERATURE SEARCHES AT HRTC

Janette Dominguez
High School Apprentice School
Harlandale High School

While working in the Instructional Design Branch at the Human Resources Laboratory, I did not only have the opportunity to experience what a scientist work environment is like, but I had the task of providing the scientists with information by conducting literature searches. A small research study was done, which involved how I would construct a mental model and guidelines for doing literature searches. After being exposed to both the GAIDA and PLS-ID Advisor programs provided by my branch, I revised my steps on doing literature searches. The main objective was to see which set of instructions in the programs did I apply to develop my procedure on literature searches for learners.

EMISSION SPECTROSCOPY OF A 30kW AMMONIA ARCJET RUN AT 16kW

Brandon J. Ellena
HSAP Student
Electric Propulsion
Propulsion Directorate
Phillips Laboratory

Abstract

Emission spectroscopy of an arcjet plume was studied. The object was to determine the electron temperature of the ionized propellant. An arcjet, spectrometer, and optics array were used to gather the data. Results found the temperatures to be within expected ranges and compared well to documented experimental data.

General Optics

(The Clueless Summerhires Guide to
life at Phillips Laboratory)

Blake Ethridge

Phillips Laboratory, PL/LIMI
Kirtland Air Force Base, N.M. 87117-6008

1.0 Introduction

Hello. My name is Blake Ethridge, but I guess you figured that out from the title page and from that little heading at the top of this page. Well I guess you have also seen the title of this paper. Let me explain. I have worked at Phillips for two summers and over that time I have picked up some helpful hints on optics and general survival, and I would like to pass them on to you, the new clueless summerhire, apprentice, internist or any other person who basically does not know what they are doing or why they are doing it.

Actually I know very little about optics. I know what I have learned by trial and error or what some annoyed scientist has told me after I made a blundering stupid mistake (this happened a lot but the scientists that I worked with were pretty patient). Believe me when I say this it really isn't that hard to pick up how to work with optics, you could probably train a blind monkey to do it, it just takes many hours of working at the optics table and fiddling with the equipment. And if you are ever interested I am sure that you could get a grant from the government to try and train a blind monkey to work with optics, but I would prefer to stay away from the monkey training field, entirely.

THE MODIFICATION OF A FACILITY DISPLAY AND RECORDING SYSTEM

James Cory Felderman

Graduate, Tullahoma High School

Freshman Electrical Engineering Student

Carnegie Mellon University

Abstract

The possible methods of improving the software of a facility display and recording system for the study of jet engine tests were analyzed. The process was begun by reading through the code already written in order to become familiar with the main objectives of the system. Necessary changes and modifications were coded into the programs so that they would be better suited for the testing of turbine engines. In order to accomplish these adjustments, FoxPro 2.0 and QuickBASIC 4.5 handbooks were consulted. Eventually, the programs were adjusted to be more user-friendly and self-explanatory: Few instructions to the users of the programs were necessary, and all that was essential for the displaying and recording of turbine test data was added to the programs.

FROM 80 CENT THERMOCOUPLES TO MULTIMILLION

DOLLAR AIRCRAFT

Daniel E. Feucht
High School Apprentice
West Carrollton High School

Abstract

During my summer experience with WL/FIBT I learned and experienced many ew things. I also got to work with many interesting people during my time ith WL/FIBT. Aircraft go through many vigorous testing environments and aneuvers in the course of one lifetime. At FIBT they test the fatigue of ne aircraft while performing these maneuvers while at the same time applying oads to them. During my time here I participated in many tests including: ne "Lightly Loaded Splice Subcomponent," "Elevated Temperature Aluminum esting," burst tests, and F-15 and fuel tank fatigue testing. Most of my ime was spent designing a Pressure Dump Manifold for tests to be run in the uture. This was designed to release all pressure to the test specimen if omething was to go wrong. The making of this manifold helped me to develop understanding of the Design-Cad 3d system better.

ESTABLISHMENT OF PARTITION COEFFICIENTS FOR THE HALON REPLACEMENT CANDIDATE BROMOTRIFLUOROMETHANE

D. Joshua Finch

Abstract

The amount of bromotrifluoromethane gas that was absorbed by specific rat tissues was measured over various time periods. The optimum time period for the absorption of the chemical into the tissue sample was then decided upon. Further samples were then incubated for the "optimum time" and then measured for their chemical content in order to establish partition coefficients for the stated chemical. The data obtained from the partition coefficient study can then be coupled with results from a gas uptake study on the same chemical and used to generate a physiologically based pharmacokinetic model to predict the human health hazards that may occur from the inhalation of bromotrifluoromethane.

A STUDY OF METHODS OF DEVELOPING A CARBON-CARBON STRUCTURAL FOAM

Jeremy D. Focht
Beavercreek High School Graduate

Abstract

The formation of a carbon-carbon foam that would possess all the characteristics of a solid composite material was desired in this experiment. A carbon mesophase pitch was used to form the actual carbon-carbon material itself. In order to create the kind of foam desired, two methods were attempted. The first was the mixing of the pitch with a nitrogen-releasing blowing agent. The second was the saturating of the pitch with highly pressurized toluene. Experimental results show that the use of the blowing agent creates foams with cells too big to retain any practical portion of the strength of the composite material itself. Pressurizing the pitch with toluene showed much better results with cell sizes within acceptable limits. However, the foams created by this method were shown to contain closed cell structures, which indicates incomplete penetration of the pitch and consequently, incomplete foaming in certain parts of the sample.

STUDYING THE TRANSMISSION CURVE OF KTP

Jennifer A. Foley
High School Apprentice
Electro-Optics Sources Branch
Wright Laboratory, Wright Patterson Air Force Base

Abstract

The characteristics of the nonlinear crystal KTP were studied primarily using the Nicolet FT-IR. The Perkin Elmer Lambda 9 was also used, though, to measure the transmission of KTP. These instruments measure the transmission of specific wavelengths through a substance. This study lead to the testing of different techniques for using the Nicolet and the Perkin Elmer. During an experiment, certain aspects, such as the amount of time the compartment had been purged, were altered to see how the measurement was affected. By attempting different methods, it is believed that the best possible results were found for studying the crystals. Once this was done, the true transmission of a 10mm long crystal was determined. This was accomplished by subtracting out losses in transmission due to Fresnel reflection and absorption of water vapor and carbon dioxide. An equation was also developed to predict the true transmission of a KTP crystal despite its length. Data from the transmission of two other crystals, 7mm and 13mm in length, were used for predicting the transmission of a 10mm long crystal. The predicted and actual transmission curves show excellent agreement.

ANALYSIS OF AQUEOUS FILM FORMING FOAM WITH THE 960 AUTOCHEMISTRY SYSTEM

Angela D. Foth
High School Apprenticeship Program
A. Crawford Mosley High School

__Abstract__

A study of anionic and non-ionic surfactants was conducted on a variety of samples using the first derivative titration method. All samples were analyzed using the same sample technique, yet each method was developed to optimize the analysis for each sample. The study was conducted using the ORION 960 Autochemistry system and the ORION surfactant electrode. Prior to this study, methods had already been developed and verified by ORION to test for surfactants using the first derivative titration method with the ORION surfactant electrode. The purpose of the study was to see how much surfactant is left in waste water after it has extinguished fire so it can be safely released to waste water treatment plants.

OBJECT-ORIENTED PARALLEL PROGRAMMING IN DERIC

Brendon P. Fowler
Summer Apprentice

Abstract

The benefits of distributed computing obtained through the use of multiple computers, to a simulation was examined. In order to create this distribution, the object-oriented computer language DERIC, which was created at the Rome Laboratory, was used to make objects in different environments aware of each other, allowing for interaction between objects in different environments and an eventual decrease in the time needed to run the simulation. One of the keys to distributed simulations is synchronization, for false information will be returned if objects in different environments complete behaviors in the wrong order. The objects in the simulation are spread throughout the computers and require a binding feature to allow them to work in tandem. The need to maintain synchronization among these objects has created several interesting problems that do not exist in single environment simulations.

This summer I was introduced to the concepts of distributed parallel processing in order to write, with the help of my mentor, the manual for the setup and usage of DERIC.

FACTORS ASSOCIATED WITH DECOMPRESSION SICKNESS

Alejandro Garcia
High School Apprenticeship Program
Sustained Operations Branch
South San Antonio High School

Abstract

Decompression sickness (DCS) is a disease that remains mysterious - its long term consequences are not known. An anonymous survey was conducted and sent to active and retired High Flyer (U-2/TR-1) pilots. These surveys were compiled and responses entered into a database to investigate the severity, occurrence, duration, and affects of DCS symptoms. The results showed that DCS symptoms occurred inflight, with the duration of symptoms lasting on the average of an hour and a half. Furthermore the symptoms typically resolved during a flyer's descent to ground level but are not limited to this. The survey documents the self-reported incidence of DCS in this population. It was not able to document any long term effects or complications associated with exposures to DCS.

My Summer Apprenticeship At Kirtland Air Force Base, Phillips Laboratory

Andrea Garcia

As I walked through the SX (Space Experiments) building for the first time, at Kirtland Air Force Base, I had no idea what to expect. My heart was racing as I looked for the office, where I would spend the next eight weeks. As I reached my destination I became more relaxed, but I still did not know what to expect. I did not know what I was going to be doing, who I was going to meet, or what I was going to learn. My adventure was just beginning as I turned and walked into the office.

As I entered I met Mr. Jeff West, my mentor. Soon Rudy showed up, my co-worker, I was going to be working with him for the next couple of weeks. As soon as I was arrived we started to meet new people. We were able to go to the computer laboratory at Phillips Lab. There we were able to see some of the biggest and fastest working computers in the world. After going to the computer lab we went to get checked in. We received our clearance badges, and we now were official members of the Phillips Laboratory staff. As we went to finish getting cleared we toured the many buildings of Phillips Lab. On this day we learned of what one of our tasks was going to be. We were going to be working on the High Altitude Balloon Experiments Project (HABE). We were not only going to be working on this project, but we would actually get to see it happen.

The lift off was going to happen on June 16, 1993 in Clovis, NM, at approximately 6:00am. To be there on time we left at midnight. The first part of the lift off was to fill the tow balloon (figure 14-1) with helium. We waited

A STUDY OF THE PHOTOELECTRIC EFFECT FOR POSSIBLE DETECTION OF BIOLOGICAL AEROSOL PARTICLES

Stephanie J. Garcia
High School Summer Apprentice
Vision Biophysics Lab
Clinical Sciences Division

ABSTRACT

The photoelectric effect was studied and two experiments were developed to demonstrate the effect. The photoelectric effect occurs when photons excite the valence electrons of a metal with enough energy to cause the electrons to escape the surface. The measured stopping potential is related to the substance's work function. The photoelectric effect seems to offer possibilities for the detection of biological aerosol particles for environmental health, medical, occupational, and defense reasons.

An RCA IP39 photocell illuminated with monochromatic visible light was studied initially. Data yielded a graph used to calculate Planck's constant, h. The other experiment involved a sample chamber illuminated with a (UV) deuterium lamp. Samples tested included non-metallics, metallics, salt, and an amino acid. Only metallic samples produced an observable effect. Further study of biological aerosol detection is required.

THE EFFECTS OF CHRONIC +Gz EXPOSURES ON RATS

Jeffrey Gavornik

Abstract

We studied the effects of chronic multiple and single exposures to high +Gz in rats using a small centrifuge in order to determine the effects of GLOC on the various body systems. Over a six week period we daily measured food intake, body weight and temperature of the experimental and control animals. Using surgical implants we also collected EEG and ECG signals from the animals prior to, during, and after the centrifuge run. At the end of the experiment various organs were removed and weighed and blood samples were collected to be analyzed. All data is preliminary but the trend appears to point towards a positive adaptation in the rats to chronic G exposures.

Mark Giles's report not available at time of publication.

AN INTRODUCTION TO BASIC ORGANIC LABORATORY TECHNIQUES

David Ginger
High School Summer Apprentice

Abstract

Basic techniques of organic chemistry were studied and applied. Such techniques included vacuum and fractional distillation, purification and recrystallization, thin layer chromatography, column chromatography, and the collection of infrared spectrum. In addition, several reactions were carried out under the direction of M. H. Dotrong.

Christopher Gonzalez's report not available at time of publication.

AUTOMATED HISTOGRAM FUNCTONS FOR SENSOR FUSION ANALYSIS

Christie W. Gooden
High School Apprentice
Seeker Technology Evaluation Branch
WL/MNGI

ABSTRACT

Currently, the data fusion work being done by WL/MNGI utilizes LADAR data obtained from the Submunition Guidance program. This display and image processing software provided with the data proved to be inadequate. The goal of this project was to provide histogram statistic capability for use with the data and display software. Initial software adaptions produced approximately forty pages of output that then required 1 - 2 hours of manual analysis to extract the desired range of information per image. The output has reduced to 1-2 pages, and requires no perusal. To achieve this reduction of output, Pascal programming was reviewed and then used to modify an existing program. This improvement enables the user to receive the necessary data quickly.

Triangulation Using FM Stations

Holly L. Grabowski

Abstract

Global Positioning Systems have been developed for the purpose of determining the coordinates of desired locations on the globe. However, GPS's are costly and an inexpensive replacement has long been sought after. Triangulation is a technique often utilized in finding the coordinates of an unknown location. This technique is currently being implemented to determine the coordinates of an antenna at Hanscom Air Force Base in Bedford, Massachusetts. Local FM stations are the tools which will allow this triangulation to take place. A direction finding device can be used to determine relative azimuth angles of the signals of specific FM stations. These angles, along with the known coordinates of the FM stations, allow for the location of the coordinates of the antenna in question. A computer program was written to process the angles and coordinates, average the results of several triangulations, compensate for errors and noisy signals, and come up with the best coordinates for the antenna. The computation of the coordinates of the antenna at Hanscom AFB alone is not an amazing discovery. However, if these coordinates can accurately be found by the method described above, there is potential for an economical replacement for Global Positioning Systems using existing resources such as FM frequencies.

Rome Labs Video Bulletin Board

David Gurecki

Abstract

Timely and effective communications are a necessity of the work environment. It is very important that people have knowledge of important events which directly affect their careers and lives, or just benefit them on a daily basis. Normal means of communication (fliers, bulletins, etc.) are often inadequate. This project is an attempt to develop a better means for getting pieces of information to their destinations.

The project involved setting up a Video Bulletin Board throughout one of the buildings of Rome Laboratory. This new system supplements, but does not replace, the old methods (e.g., distributing bulletins), which can take a long time for everyone to actually receive the information.

This document will describe the routines and modifications made to the original commercially developed software system. Without these modifications, the Video Bulletin Board software could not have been used for this application.

Melissa Hanna's report not available at time of publication.

FACTORS INFLUENCING THE DEPOSITION OF POLPYRROLE FILMS

Deanna Harrison
High School Apprentice
Fuzes Branch
Wright Laboratory Armament Directorate

Abstract

Most polymers are insulators, such as plastics, but a few that have been recently developed are conductive. There has been a great deal of experimentation done with conductive polymers, and in many cases important factors have been ignored or left unreported. Since this is a fairly new field of study, many factors that affect the quality of the films are still unknown. If all of the factors that influence film deposition are not analyzed, data gathered in experimentation can be deceiving. Each factor must be identified and studied in order to attain accurate and consistent results. The purpose of this project was to determine what factors influence the quality of polypyrrole films and how each factor affects them.

A STUDY OF THE MECHANICAL DRIVE SYSTEM

David B. Hartsock
Apprentice
Operations Group

During my summer job at the Compressor Research Facility (CRF) I was involved with the Mechanical Drive System. The CRF is presently upgrading their drive system. This allowed me to do an intricate study of the CRF's Mechanical Drive System. The majority of my job I was studying up on the design requirements so I would be properly prepared when we needed to make the new designs for the drive system.

VALIDATING THE FPASP4 SOFTWARE DEVELOPMENT ENVIRONMENT

Eric Hayduk

Abstract

The validation of the FPASP4 (Floating Point Application Specific Processor v 4.0) software development environment was initiated. To validate the FPASP4, basic language structures were written in C, compiled in MIPS R3000 assembly language, translated into FPASP4 assembly language, then evaluated by using a simulation of the FPASP4 chip. The results show that many of the basic language structures tested translate and function properly. Results also show that some of the language structures tested were either mistranslated or did not function properly. These language structures point to problems with both the assembler and the translator. In some cases, the MIPS assembly language instructions were mistranslated or were not supported by the translator, while the assembler did not accept some of the required MIPS assembler directives. Tested structures are discussed along with problems, corrections, and future steps to complete validation.

HIGH SURFACE-AREA CONDUCTIVE POLYMER FILMS USING AN AMMONIUM CHLORIDE AQUEOUS SOLUTION

Laura Hemmer
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Fuzes Branch
Wright Laboratory Armament Directorate

Abstract

In recent years, researchers have found numerous applications for conductive polymers. For example, polymer films can serve as electrodes in capacitors [1].

The goal of this project was to increase the surface area of conductive polymer electrodes thereby increasing their capacitance. The method tested was to increase surface area by coating polymer electrodes of dodecylbenzenesulfanate (DBS) doped polypyrrole (PPY) with chlorine doped polypyrrole electrodeposited from an ammonium chloride (NH_4Cl) aqueous solution (Figure 1.) These textured polymer electodes were then used to make a double layer capacitor [2].

J6 Large Rocket Test Facility

Steam System Math Model Validation

T. Thao Hill

1993 Graduate, Tullahoma High School

Freshman, Department of Electrical Engineering

The University of Tennessee College of Engineering

Knoxville, Tennessee 37996

Abstract

The J6 Large Rocket Testing Facility steam system was designed to perform to very specific requirements. A math model for the steam system was developed early in 1993 to provide a tool to be used prior to and during system activation. System data was obtained during a manual blowdown of the system on April 23, 1993. The data was compared to math model simulation data. Results indicated that there was a significant difference between actual and model predicted system performance. Equations of the model were reviewed. Component performances were modified, and the modifications were made in an attempt to be comparable to the real data. In doing so, possible areas of error in the model equations could be detected. These results will be used in the final preparation for activation of the J6 LRTF.

TRANSVERSE INJECTION STUDIES INTO A MACH 2 FREESTREAM

Melanie L. Hodges
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Advanced Propulsion Division
Wright Laboratory
Wright-Patterson Air Force Base

Abstract

Transverse injection studies were performed in a Mach 2 freestream using schlieren photography and Mie scattering with carbon dioxide as the injectant. The turbulent structure and penetration characteristics of three typical injector geometries were examined. One of these was positioned at a low angle to the freestream while the others were injected perpendicular to the freestream. Results of the schlieren photography revealed typical features of the flow including a bow shock, barrel shock, Mach disk, and recirculation zones. The Mie scattering images showed a variety of flow structures along the boundary between the jet and the freestream. These structures were more evident in the flowfields created by the perpendicular injectors than by the angled injector. This preliminary research merits further analysis and investigation.

USING NEURAL NETWORKS FOR THE DETECTION OF POTENTIAL TARGETS IN AN IMAGE SEGMENTED BY FRACTAL DIMENSION

Mark E. Jeffcoat

High School Apprentice

Advanced Guidance Branch

Abstract

This paper discusses the use of neural networks to detect potential targets within an image, specifically one from the Advanced Technology LAdar (Laser Detection and Ranging) System (ATLAS) program. The ATLAS sensors include a Ladar beam and an infrared sensor. This research included only the active (range) and passive (infrared) sensor data. A neural net removed defects from the active images, caused by atmospheric interference with the Ladar beam (not present in the passive images). A neural net separated an image into road, building, and natural pixels, given both the original and fractal dimension data, with very few unknowns or errors.

THE AURORA BOREALIS AND THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM

Tiffany J. Jost
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Phillips Geophysics Laboratory
Lincoln-Sudbury Regional High School

ABSTRACT

The Aurora Borealis and Aurora Australis are phenomena in the space environment resulting from the flowing current of the sun's plasma through the stored plasma and atmospheric gases already present in the Earth's atmosphere. The position and color of the Northern and Southern Lights depends on the activity level in the ionosphere. This activity is monitored under the Defense Meteorological Satellite Program.

COMPUTER-AIDED DESIGN OF
TWENTY-FIRST CENTURY HEDM MATERIALS

Alexandra R. Kitty
Good Counsel High School

Abstract

Semi-empirical quantum mechanical methods used to determine the heats of formation of High Energy Density Materials (HEDMs) were studied. The goal was then to use computation to predict the specific impulse (or I_{sp}) of these materials, thus narrowing down the experimental search for improved HEDM materials to the most promising synthetic targets. In order to achieve this goal, the MOPAC™ module within the GAMESS (General Atomic and Molecular Electronic Structure System) program was used to calculate optimized molecular geometries and heats of formation for each of forty-nine HEDM targets. Three different semi-empirical methods, Parameterization Method 3 (PM3), Austin Method 1 (AM1), and Modified Neglect of Differential Overlap (MNDO) were evaluated. Upon comparing the calculated heats of formation to experimental values, it was found that the PM3 calculations came closest to the experimental heats of formation. Inspection of the data shows the PM3 method to be able to predict the heats of formation of HEDM molecules incorporating a variety of relevant functional groups with errors of 8.6 kcal mol^{-1} (average absolute error) and +3.4 kcal mol^{-1} (average total error). A plot of experimental versus PM3 heats of formation shows a coefficient of determination of 0.91, a slope of 0.9348, and an intercept of -0.1740, very close to ideal values. The I_{sp} of select molecules from the forty-nine HEDM targets were calculated, using experimental and calculated heats of formation, to test the sensitivity of the I_{sp} determination to the heat of formation. It was found that great differences in heats of formation generally do not mean great variations in I_{sp}.

ELECTRICAL ANALYSIS OF $YBa_2Cu_3O_{7-x}$ SUPERCONDUCTING THIN FILMS AND BULK SAMPLES

Peter G. Kozlowski
Centerville High School

Abstract

High temperature superconducting thin films and bulk samples of the Y-Ba-Cu-O system were studied in order to characterize their electrical properties. The preparation of high critical temperature $YBa_2Cu_3O_{7-x}$ films on single crystalline $SrTiO_3$ and Al_2O_3 was done by laser ablation. In all cases, c-axis oriented films with critical temperature of about 90 K were obtained. On patterned films we obtained a critical current density of 10^6 A/cm^2. Bulk samples, having a much larger cross-sectional area, exhibit lower critical current densities, approximately 10^3 A/cm^2. Both thin films and bulk samples were measured by a four point technique and were tested through a range of temperature from 77 K (liquid nitrogen) to 300 K (room temperature).

EFFECTS OF VARYING GAUGE LENGTHS ON "MINIATURE SPECIMEN" INSTRON AND SPLIT-HOPKINSON TENSILE RESULTS

BARRY W KRESS
HIGH SCHOOL APPRENTICE
WARHEAD BRANCH
WRIGHT LABORATORY ARMAMENT DIRECTORATE

ABSTRACT

A new miniature tensile specimen is proposed for use in the evaluation of explosively formed penetrators (EFP'S) liners. This is necessitated due to the desire to evaluate "real life" liners that are fully processed and too thin for machining current tensile specimens. Tensile testing was performed at both low (Instron) and high (Split-Hopkinson) strain rates and results compared back to the current 0.125" diameter/0.350" gauge length sample. The proposed miniature specimen size requirement was established as 0.090" diameter because of liner thickness. Various gauge lengths were evaluated from 0.214" to 0.304" in 0.030" increments. Since the average results varied no more than 1.11% for all gauge lengths tested, the 0.244" gauge length was chosen as the new length since it preserved the gauge length/diameter ratio of the current tensile specimen. From the tensile tests performed, the average stress for the 0.125" diameter specimens was 266 KSI and the 0.090" specimens was 269 KSI. The difference between the two was 1.12% which is well within experimental error.

Ion Implantation Simulation in Three Dimensions

Joel Kulesa
Archbishop Alter High School
Bradley University
Peoria, Ill

Dr. Charles Cerny
Wright Laboratory
Wright Patterson AFB, OH

Abstract

A program that simulates Ion Implantation was developed so that an aging BASIC program could be replaced. This program would not only duplicate the former program but would improve upon the existing program through better simulation and improved graphics plotting routines. The result was a package written in portable C on the Sun workstation that could be easily expanded in the future. In-house simulation routines such as these prove how computer simulations make electronic designs much cheaper and less labor intensive.

REDUCTION AND ANALYSIS OF EXTENDED X-RAY ABSORPTION FINE STRUCTURE (EXAFS) DATA

Brad M. Lormand
Student
Rosamond High School

Abstract

Previously obtained synchrotron radiation absorption data was reduced to a usable form and analyzed to determine structural properties of the involved species. The compounds being tested included Rubidium perchlorate, a Bromohydroquinone-Terepthalyic acid polymer, and the Bromohydroquinone monomer by itself. The acquired data was reduced using the computer program Genplot (by Computer Graphics Service, Ltd.).

A STUDY OF ARRAY ANTENNAS AND NEURAL NETWORKS FOR FUTURE APPLICATIONS IN DIRECTION FINDING

Adam Maloof
High School Apprentice
Lexington High School

Abstract

Various types of array antennas were the subject of this study. The investigation focused on the patterns in wave data observed when the value of theta (the angle of arrival, i.e., the angle at which a transmitter's phase front strikes an element of an array antenna) was increased or decreased. Phase and amplitude patterns were observed and plotted for selected values of theta with an eight element phased array lab antenna. Computer programs were written to simulate and plot 1) theta for different element spacings of a two element array, and 2) the phase difference between elements of a three element array for different thetas. Ultimately, these programs will serve as the foundation for developing an advanced direction finding mechanism. The data collected from the lab array will be used to train a neural network capable of describing theta for any given wave data. This neural network might also find application as an efficient direction finding device.

SGAP MODEL BUILDING

CHRIS MARLOW
TENNESSEE TECH. UNIVERSITY
AEDC

ABSTRACT

The Grid Graphical Analysis Package (GridGAP) computer system was used to obtain computer visualizations of wind tunnel test collisions. The GridGAP software is a derivative of the Store-separation Graphical Analysis Package (SGAP) and both programs recquire the same model format. The GridGAP computer system displays animated three-dimensional projections on a workstation graphics monitor using store position and orientation data. The views can be translated, rotated, and scaled so that the operator can assume any desired vantage point from which to evaluate the store's movement. Wire-frame or panel computer models of the Captive Trajectory Support System (CTS) for the sixteen foot transonic wind tunnel which ranges from Mach 0.06 to Mach 1.6 were built. SGAP model building involves many steps. Locating dimensions for the part is the first necessary step to build a SGAP geometry model. Critical points must be located and coordinates for the points assigned. The point coordinate data is input into a data file, and an executable program is run which creates an output file in which the points are arranged in facets. With the facets a picture can be drawn and a verification of the dimensions and model accuracy can be made. Once SGAP files have been made for all the individual pieces, they can be put together in the correct configuration in accordance with the wind tunnel test installations. With the configuration files the GridGAP program can be run to show how the CTS, aircraft, and stores react with each other.

MAPPING COMPUTER NETWORKS

Amy Martin
High School Apprentice
Computer Resources Team
Kettering Fairmont High School

Abstract

The mapping of the computer networks in building 450 and 24C was done. Previous maps were scanned in on Paintbrush, cleaned up, and corrected, or hand-drawn sketches were made into graphs. Harvard Graphics was used tot type in a report for a Technical Management Review. Familiarity was also gained with WordMarc word processing, the aircraft inventory data system, BTS Disspla, the UNIX and PRIME systems, and Silicon Graphics.

THE SUN

SUZANNE MATTHEWS

ABSTRACT

The project's objective was to set up a Sun Microsystems computer workstation to receive, decrypt, and analyze data from an unspecified satellite. Five Sun SPARC-station 10 systems were used. They are linked together by two Ethernets, one set on the default, and an extra to handle classified data.

Eric McEuen's report not available at time of publication.

FINAL REVIEW OF SOFTWARE PACKAGES USED IN VARIOUS COMMUNICATION APPLICATIONS

Scott McGovern
Junior
Bellbrook High School

Abstract

Contained within this report are evaluations of software packages used in the day-to-day operation in electronic warfare and communications. Harvard Graphics, Mathcad, DADiSP, Graph Tool, Microsoft Visual Basic and Excel were evaluated. A brief explanation of each program will be followed by the application for which it was used.

A STUDY OF THE MINIMUM DEVIATION METHOD FOR REFRACTIVE INDEX MEASUREMENTS

Sandra R. McPherson
High School Apprentice
Bishop Brossart High School

Abstract

The index of refraction, which is a measure of how light travels through a substance, is a basic characterization done by scientists after a new material is created. We discuss three types of crystalline material and how to measure each one's refractive index. A spectrometer is used to record the data and we discuss how the data is taken and analyzed. Indices at several wavelengths need to be done because of dispersion. Five runs are done on each prism and a standard deviation (STD) is calulated on the computer. Quartz was used as a practice sample until our STD was below 10^{-3}. When that was accomplished new materials from Crystal Associates, RTA and KTP:Na were measured. The data taken proved to be accurate enough for use and the index measurements were sent to Crystal Associates to be used.

Object-Oriented Systems Analysis

Sean A. Menge
Rome Laboratory
Griffiss Air Force Base, Rome N.Y.

Abstract

An in-depth look at the up and coming and very successful object-oriented analysis methodology was conducted at Rome Laboratory in order to determine an appropriate technique for software analysis of a future D.D development effort. Two well known techniques, Shlaer-Mellor, and Rumbaugh, were compared and contrasted in order to determine which would be most applicable to Rome Lab's problem. The overall results of the research provided Rome Lab with excellent information on which to base their decision of which techniques should be utilized for the future development effort. This paper provides the reader with background information from which the choice of an appropriate object-oriented analysis technique can be made. The paper concludes a very exciting and enjoyable eight weeks at Rome Laboratory.

ELECTRONIC DOCUMENTATION AND DESIGN

Benjamin J. Merrill
Bellbrook High School

Abstract

My apprenticeship was hosted by the Flight Dynamics Control Integration and Assessment Branch of Wright Laboratories. I was involved with a few of the many different kinds of work that go on here. My main focus was on the documentation of electronic devices and the components that make up these devices. I also did some designing of digital circuits and the initial testing of these circuits. Overall, I feel I've learned a great deal about what it's like working in an office environment, and have a good feel for what I can expect in the fields of engineering and science.

An Experience in Structures Testing

Charles J. Middleton

ABSTRACT

I was assigned to Wright Laboratory, Flight Dynamics Directorate, Structures Test Branch, under Amar Bhungalia, project engineer, at Wright Patterson Air Force Base. I worked with my mentor along with various other engineers and technicians on a diverse group of projects during my stay there. I assisted on the setup of the Fuel Tank Test Methods and the Elevated Temperature Aluminum Program (ETAP). I designed, edited, and redesigned a hydraulic manifold for use on the ETAP using DesignCAD-3d on a Unisys PW² Advantage computer. I helped to create a Macro program for the analysis of data for the F-16 Transparency Evaluation Test. I assisted in the design of the structural framework for the Structural Assesment Vulnerability Evaluation. I assisted in running the Leading Edge Flux Meter Calibration Test and analyzing data for it. I worked in preparing and constructing graphite composites in the Composites Lab. I was also able to view the Lightly Loaded Splice Subcomponent Fatigue Testing, the Conductive Shield Heat Exchanger Sub-Elements X-30 Nozzle Active Cooled Structure Fatigue Test, and the F-15 Wing and Wing Carry-Through Structure Fatigue Test.

A Comparison of Feature Conjunction Tasks

Virginia Miksch

A feature conjunction task was developed in two dimensional space on a Silicon Graphics 3130 IRIS computer system. The task tested the advantages and disadvantages of a feature conjunction task using either size/orientation or color/orientation. Six employees at Armstrong Laboratory volunteered to serve as subjects for study. An upper right field advantage was shown using the color/orientation medium, but the size/orientation medium showed the overall upper field advantage.

DEVELOPMENT OF AN ENGINEERING ANALYSIS TOOL USING FORTRAN

Elliot Moore II
High School Apprentice
Warheads Branch
Wright Laboratory Armament Directorate

ABSTRACT

For a second summer, I worked as an apprentice to Mr. Michael E. Nixon. in the computational mechanics section of the Warheads Branch. My project involved the development of a FORTRAN program to be used in testing strain values from Taylor Impact Specimens. The main purpose of the program was to find the location of elastic/plastic interface, as a function of time. The location is based on given strain criteria. The elastic/plastic interface data are points written to a separate file for use with the Microsoft EXCEL spreadsheet. The data was then plotted and used for analysis by the engineer.

Examinee Selection of Recycling Instructions or Practice Items for Computer Administered Tests

Rebecca C. Mortis
Student
Incarnate Word High School

Abstract

Computers have revolutionized the testing world. Providing practice items along with the instructions for a test and then giving the examinees the chance to recycle the instructions and/or practice items are just a few of the options that are now made available through computerized testing. An analyses of examinees' performance on sixteen subtests, measuring cognitive processes, was conducted to determine whether the option to recycle the instructions and/or practice items affected the examinees' subtest performance. It was concluded that the option to recycle did not have a profound effect on the examinees' overall subtest performance.

BALANCE CHECKOUT PROCEDURE PROGRAM FOR PITCH, ROLL, AND YAW

Gilbert G. Morton

Tennessee Technological University

Abstract

The balance checkout process is a very complex procedure that involves many calculations. My project was to design a program to cut down on the number of manual calculations in order to ge a quicker analysis of the situation. By inputing a few numbers in a spreadsheet, the required parameters will be calculated in much less time.

THE ROLES OF VETERINARY MEDICINE IN BIOMEDICAL RESEARCH

Laura Neitzel
RDL Apprentice
Comparative Pathology Branch
Armstrong Laboratory

Abstract

My summer apprenticeship was spent in the veterinary Sciences Division of Armstrong Laboratories. I worked in the Comparative Pathology and the Research Support Branch. In Comparative Pathology my main job was to stain tissue placed on microscope slides, for viewing by the pathologist. I also worked in the Electron Microscopy Section where I helped in a scanning electron microscopic study of arthritic monkeys. In the Research Support Branch I helped with the transfer of information to medical records and observed physical exams performed by the laboratory animal veterinarian

Data Analysis For The Evaluation Of The Effects Of Variable Head-Mounted Weight On Human Response During +Gz Impact Accelerations

Quynh Trang Nguyen
High School Apprentice
West Carrollton High School

Abstract

"The Evaluation Of The Effects Of Variable Head-Mounted Weight On Human Response During +Gz Impact Acceleration" is a research project that deals with the hazards of helmet enhancements such as night vision devices and helmet mounted displays. During a seat ejection, the pilot has a potentially higher risk of developing neck and spinal injury because of the increased mass, moment of inertia, and shifted center-of-gravity placed upon the head. My research included analyzing the data from of the human test subjects and the Advanced Dynamic Anthropomorphic Manikin (ADAM) after they were tested on the Vertical Deceleration Tower (VDT).

RADAR NOISE ELIMINATION
UTILIZING NEURAL NETWORKS

Eric D. Nielsen
High School Apprentice

Abstract

All manners of electronic devices suffer from a problem called noise. In all situations, noise results in either a loss or a gain of information. With radar this problem manifests itself in the form of pseudo-contacts -- contacts that do not exist in the real world. These noise contacts can cause numerous difficulties for people and computers that must use the radar data. One of the more common applications that uses raw radar data is a computerized tracking system. When one of these programs receives data distorted by noise, the tracking program will have problems in deciding which contacts to link. This can lead the tracking application to link a valid contact to a noise contact, a noise contact to a valid contact, or a noise contact to another noise contact. The pairing of contacts is vital to the calculation of tracking data for the tracked contacts. All three of the mentioned situations can lead to difficulties. Planes sent out to intercept a contact might not find it, wasting valuable resources. To help solve this problem, a neural network attempted to filter out the noise before it reaches the tracking stage. A C program, that takes the raw radar data and calculates other more important values from it, controls the execution of the neural network. The C program passes the neural network a list of values for each contact. The network then determines the validity of each contact. Tracking programs and other applications that need this filtered data can then receive it from the C program.

INFRARED BORESCOPE EVALUATION

CHRIS NORTHCUTT

GRADUATE of FRANKLIN COUNTY HIGH SCHOOL

TENNESSEE TECHNOLOGICAL UNIVERSITY

ABSTRACT

The usefulness of an infrared borescope was evaluated through a series of laboratory tests. Tests were performed to measure the emissions from small scale heat sources. A two diameter blackbody set at a temperature of 200°C was scanned by the infrared borescope, and the data taken was digitized and converted into an image on a personal computer. The images provided a view of the blackbody with different colors indicating the varying heat emissions.

Activity Coefficient Determination for 1-Methyl Naphthalene and Hexadecane: Water System

Amanda L. Olson
High School Apprenticeship Program

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Abstract

A study of the partitioning of 1-methyl naphthalene between a layer of hexadecane and water was conducted. An amount of 1-methyl naphthalene was injected into a flask containing hexadecane and water. The solution was allowed to equilibrate for a minimum of 48 hours, an aliquot of the aqueous layer was then extracted and analyzed by injecting into a gas chromatograph to determine the aqueous phase concentration. The top layer was diluted and analyzed to determine the concentration in the organic phase. These values were then used to calculate the activity coefficient.

As part of this study, method development was performed to determine a qualitative and quantitative measurement by GC-FID. The extraction technique was demonstrated by an extraction study that proved acceptable recovery, reproducability, and accuracy.

Previous solubility studies have been conducted, but with pure forms of the chemicals. The results from this study will be incorporated into groundwater transport models. These models will help to determine the fate of groundwater contaminants, make contaminant cleanups more efficient, and help in developing methods for slowing down the spread of these contaminants.

CONDUCTING LITERATURE SEARCHES: MY SUMMER EXPERIENCE

Kimberly Ondrusek
High School Apprenticeship Student
Brooks Air Force Base

Abstract

The summer research I conducted, consisted mostly of using the literature search machines. I used them to help assist in some of the research needed for the scientists in my department. Once I learned how to use the literature search machines, my mentor gave me a project. I wrote a step-by-step procedure on how to use the literature search machines. The next phase of my project, was to revise it using the nine events of GAIDA, which were previously developed by my branch. The third phase of my project was to again revise my first draft, using the program PLS ID Advisor.

THE EFFECTS OF MOISTURE ON THE TENSILE STRENGTH OF CONCRETE

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WLFIVCS, Tyndall AFB FL 32403-5323

ABSTRACT

The study measured the effect of moisture on the tensile strength of concrete. Forty-six samples were cut from the same J-Mix concrete. The samples were divided into three groups; each group was exposed to different moisture levels. Sixteen "wet" samples were tested after remaining in water for three days. Fifteen "half-dry" samples were tested after being dried in an oven until their moisture was decreased by 5%. Fifteen "dry" samples were tested after drying reduced their moisture by 10%. Ten samples from each group were tested using the Split-Hopkinson Pressure Bar. The results were recorded on an oscilloscope; the transmitted wave was used for the calculations. The remaining samples from each group were tested on the Forney Machine for quasi-static load rates. The data showed that the "dry" samples showed higher tensile strength during quasi-static tests while the "wet" samples were more resilient at higher load rates in dynamic testing.

Multi-Media

Michael J. Panara
Summer Apprentice
Rome Laboratory
Griffiss Air Force Base

Abstract

The importance multi-media was studied. To show the importance of multi-media a tutorial for the MacroMind Director was made using the MacroMind Director application. The tutorial showed the basics of creating a multi-media project or presentation using this application. All available media was used in attempt to show the full power of the Director as well as the full power of multi-media. This showed how easily an effective interactive multi-media presentation could be made once the basic skills are learned.

EFFECTS OF THE ATMOSPHERE ON LASER RADAR

Alexander H. Penn
Summer Apprentice

Abstract

A system for measuring the effects of the atmosphere on LADAR was set up and data collection was begun. It consisted of three parts: a LADAR to take images of a fixed stationary object, a weather station to measure existing weather conditions, and a Helium Neon laser to measure the attenuation of the beam due to atmosphere. The initial medium for the LADAR has been Nd: Yag, which lases at 1.06 microns, but it will be replaced by a Ti-Sapphire laser of adjustable wavelength. Data collection to date has consisted of fair weather, rain, fog, and nighttime data. It will later cover other atmospheric conditions including snow, sleet, and high aerosol content (smoke and dust). The data when fully collected will be used to develop filter algorithms and to evaluate the most useful wavelengths under differing conditions.

Air Pollutant Detection:A Dual Use for LADAR

Kyle D. Perry
High School Apprentice
Crestview High School

Abstract

Research was done to find laser line absorbance data on various airborne pollutants in order to determine if it is possible to detect these airborne pollutants in smokestack plumes using infrared spectrometry in the 0.79 to 2.0 micron region. A computer program containing this data was eventually found and various parameters in the program were manipulated in order to fit the conditions that LADAR would be used to detect polluting emissions contained in the smokestack plume. It was found that a few molecules contained significant absorbance peaks in the 0.79 to 2.0 micron range, namely HCL, OH, HF, and CH_4.

Environmental Movement of Heavy Metals in Vegetation and Soils

Mary F. Pletcher
High School Apprentice
Environics Branch
WL/MNOE

Abstract

Currently tantalum (Ta) and tungsten (W) are used in the construction of penetrators for warheads. While the two elements have not been proven to be toxic to humans and animals, the ability of the elements to enter the food chain is unknown. Thus, this study tested tantalum, tungsten, and a tungsten alloy's abilities to enter the food chain. The project consisted primarily of a plant uptake study, however, a leaching study was also started.

The study consisted of planting two species of plants; *Zea mays 'Hunters Choice'* (corn) and *Phaseolus vulgaris 'Blue Lake'* (bean), into soils containing different exposures of tantalum, tungsten and the alloy. Plants were grown in a growth chamber insuring uniform conditions. Results from this preliminary study suggest that there will be a minimal plant uptake.

Anne Pletl's report not available at time of publication.

USAF JET FUEL THERMAL STABILITY TESTING

Daniel L. Prevost
Student
Kettering Fairmont High School

Abstract

Fuel thermal stability has always been a problem for the designers of aircraft engines who must balance component life against high temperatures, high heat fluxes and the thermal stability of fuels. Due to newer high performance and fuel efficient engines that stress fuel beyond its thermal stability limits, a large amount of maintenance time and energy is spent removing and cleaning fouled nozzles, afterburner spraybars, and sprayrings. Current investigations show that future engine systems will stress fuels even further. This has lead the Air Force to embark on a program to improve the thermal stability of its fuel. This program would increase the thermal limits of the fuel by 100°F through the use of an additive package. However, before it can be put into use any additive package must be thoroughly tested in a variety of systems in a variety of fuels in order to maximize its performance.

Bilinear Second-Order Recursive Notch Filter

Kristy Price
Graduate of Tullahoma High School
University of Tennessee at Chattanooga

Abstract

A filter is a device used to reject signals, vibrations, or radiations of certain frequencies while passing others. A digital filter does this process, which is often linear, on a set of discrete data numerically. In this particular project, a bilinear transformation notch filter, a second-order recursive digital filter that depends on previous outputs, was applied to data contaminated by 60 Hertz power-line interference to remove a narrow band around that frequency. A test case was developed which contained 60 Hertz noise. This test case was written into a source code as a sine function containing frequencies at 10, 60, and 100 Hertz. When the notch filter was applied, the 60 Hertz frequency was removed. In two additional tests, the filter also effectively removed the 60 Hertz noise. The sine function was modified to simulate real data by randomizing the 60 Hertz frequency between 58 and 62 Hertz. Also, the bilinear transformation notch filter was tested with data from an AEDC test cell. In both tests, the width of the notch had to be changed in order for the filter to work effectively. To filter the test cell data, the notch filter was applied at 40 Hertz instead of 60 Hertz to correct for the aliasing of the data.

Christopher Protz's report not available at time of publication.

SPREADSHEETS, CADS AND C

Thomas Rader

Abstract

Phillips Laboratories had many tasks to accomplish this summer and the jobs were divided between the various divisions. The divisions that I was a part of was concerned with with gathering and displaying many types of data. I was mainly involved with the display of data.

THE ANGULAR ROTATION MATRIX EXPANSION TABLE CALCULATOR

Kris S. Ray

Abstract

My main project this summer was to make a user friendly program that multiplies angular rotation matrices in symbolic form. The program utilizes the easy to use Windows operating systems and all controls are intuitive. This program will aid in future testing at AEDC.

DEVELOPMENT AND TESTING OF LIQUID CRYSTAL POLYMER SOLID ROCKET MOTORS

Tracy R. Reed

Abstract

A working solid rocket motor with all structural components made out of liquid crystal polymers (LCP's) was built and tested. The motor cases and nozzles were injection molded. Three propellant formulations with different burn rates were tested in the motors. After development and testing, the rocket motors will be sent to the U.S. Air Force Academy for their advanced Astronautics curricula.

TOOL KIT PROGRAM
(WRITTEN IN FOXPRO)

Cheryl Riddle
Moore County High School
Lynchburg, Tennessee

ABSTRACT

This computer program was written using FoxPro 2.0. The program creates a database for the tool crib of the Engine Test Facility at Arnold Engineering Development Center. Currently in use is a very limited database file that will be replaced by this program. Through the new program, there will be a complete database of all employees, tools, inventory codes, and craft codes. Employees can be linked and unlinked to their craft and their tools, inventory sheets can be comprised and printed by the computer, inventory can be completely recorded by the computer, and reports can be generated over all aspects of the job.

The Study of Dyslexic Spelling Patterns

Luis M. Rodriguez

Abstract

The Pattern Recognition and Artificial Intelligence Spelling Experiment (PRAISE) is a project running at the Air Force Institute of Technology (AFIT) by Mr. Craig Arndt, the project director. Mr. Craig Arndt is a scientist from the Armstrong Laboratory's Human Engineering Division (AL/CFHD) on Wright-Patterson Air Force Base (WPAFB). The purpose of PRAISE is to study the different variations of dyslexic spelling patterns to better understand dyslexia. PRAISE also intends to help build a spell checker that would recognize the dyslexic spelling patterns and produce alternatives for a correctly spelled word or words for the user. There are many adult dyslexics in the professional world. This spell checker would be extremely helpful for the many adult dyslexics in any profession. In order to start the project a data base consisting of the 5000 most commonly used words in the English language was developed. A plethora of documents, notes, letters, and various other forms of literature were read so as to find the incorrect spelling patterns. These patterns were extracted and inserted into our data base where they were sorted into twelve different misspelling categories such as:

1. ADDITION OF UNNEEDED LETTERS.
2. OMISSIONS OF NEEDED LETTERS.
3. REFLECTIONS OF CHILD'S MISPRONUNCIATIONS.
4. REFLECTIONS OF DIALECTICAL SPEECH PATTERNS.
5. REVERSALS OF SMALL WORDS.
6. REVERSALS OF CONSONANT ORDER.
7. REVERSALS OF CONSONANT OR VOWEL DIRECTIONALITY.
8. REVERSALS OF SYLLABLES.
9. PHONETIC SPELLING OF NON PHONETIC WORDS OR PART THERE OF.
10. WRONG ASSOCIATIONS OF A SOUND WITH A GIVEN SET OF LETTERS.
11. "NEOGRAPHISMS" SUCH AS LETTERS PUT IN WHICH BEAR NO DISCERNIBLE RELATIONSHIP WITH WORD DICTATED.
12. VARYING DEGREES AND COMBINATIONS OF THESE OR OTHER POSSIBLE PATTERNS.

SOLUBILITY AND RECRYSTALLIZATION OF 1,3,3-TRINITROAZETIDINE (TNAZ)

DAVID A. ROSENBAUM
HIGH SCHOOL APPRENTICESHIP PROGRAM
ENERGETIC MATERIALS BRANCH
WRIGHT LAB ARMAMENT DIRECTORATE

SECTION 1

1,3,3-trinitroazetidine (TNAZ) is a heterocyclic compound (energetic material) under investigation as a melt cast base for composite high explosive applications. TNAZ's high density, thermal stability, and enhanced performance over other military formulations make it suitable for high energy applications. This ability to melt cast and provide higher energy output combined with less sensitivity, makes TNAZ attractive as a military explosive. Thirty four pounds (15.5 kilograms) of TNAZ was procured by the High Explosives Research and Development (HERD) Facility in a joint action with the Army Research, Development, and Engineering Center (ARDEC) through a commercial best effort contract with Aerojet Ordinance. The TNAZ was contaminated with nitric acid. Explosive charges fabricated under hydraulic pressing at 30,000 psi, exuded nitric acid contaminating the die, ram, and press. This necessitated the removal of the nitric acid. Solvent recrystallization was chosen as the best method of purification. Solubility tests were done to determine the most efficient solvent. The solvents consisted of alcohols, water, and acetone. The TNAZ was recrystallized from ethanol by crash precipitation in distilled ice water. Drophammer was conducted to determine the impact sensitivity. Thermal analysis was completed to determine the melt point and decomposition exotherm. The structure of TNAZ was verified by NMR and FTIR, its morphology studied by Scanning Electron Microscopy, and its particle size determined. The 15.5 kilograms of TNAZ was successfully recrystallized in two batches removing all detectable traces of nitric acid contamination.

A COMPARISON OF THREE TEMPERATURE TRANSDUCERS

Carol A. Salinas

Research Assistant

Sustained Operations Research Branch

Armstrong Laboratory/CFTO

ABSTRACT

In order to better understand the physiological challenges Air Force personnel face, there is a need for accurate assessment of body temperature during field studies. US Air Force aircrew frequently encounter life-threatening temperature extremes. Body temperature is a also a good indicator of 'jet lag' or circadian dysrhythmia for crews that travel across many time zones to do their jobs. Two temperature transducers were compared to the standard rectal or core body temperature recording device. The digital oral thermometer was found to satisfactorily compare with the core device for temperature and variability of readings. The tympanic temperature probe was faster to use than the oral device but was highly variable in its readings. It was concluded that the oral temperature device is satisfactory for field use where core temperature devices are not practical.

Sally Schanding
High School Apprenticeship Program
RDL Summer 1993

Dr. Fred H. Previc

Flight Motion Effects Branch
Crew Technology Division
Armstrong Laboratory
Brooks Air Force Base, Texas

I did not conduct an experiment this summer. I spent most of my time researching subjective contour illusions in preparation for an experiment that Dr. Previc now hopes to have me run next summer.

Humans perceive contours when there is a jump in stimulation between adjacent areas (Kanizsa, 82). Jumps may be caused by a change in the color of an image or the brightness of it. However, contours can be seen in an image that is completely homogeneous.

COMPUTER SIMULATION OF RADIO RECEIVERS

William J. Schatz
High School Summer Apprentice

Abstract

An AM/FM radio receiver and the receiver's components were simulated through the use of a Macintosh IIx computer in a MATLAB environment. The simulation was performed by writing equations and algorithms defining the various components' functions; real and simulated data was then applied to these equations. A data collection unit was established comprising of a UHF antenna, an Applied Communications Receiver, a preliminary mixer, and an analog-to-digital converter. The collection unit was connected to a CompuAdd 325 computer which saved the digitized data as a binary file. An interface application was written to convert the binary data into a MATLAB compatible form. This data was then "played" using the simulated receiver.

EXPERIMENTS IN THE NONLINEAR OPTICS BRANCH OF THE PHILLIPS LABORATORY

DAVID M. SCHINDLER

This summer at Phillips Laboratories I had the opportunity to assist others on some very interesting experiments. One of these experiments was making electronic circuits. I assisted in the making of a digital peak detector and a filter circuit. The peak detector was built to detect peak light intensity. In simpler terms, this circuit could be used to measure the intensity of lasers, sunlight, or any other source of light in which the intensity is unknown. The filter circuit was the more complicated of the two circuits on which I assisted. The goal of this project was to make a frequency selective network which illuminates LED's (Light Emitting Diodes) according to a certain frequency input. This project breaks the audible frequency into three different bands; low-band (0-5 kHz), mid-band (5-10 kHz), and high-band (10-20 kHz). The concept of this was to use filters to identify frequency. For example, if a certain filter passed a signal, one could indicate which frequency band that signal was in by simply turning on a LED. These filters would also eliminate the use of inductors and if needed, could amplify the signal. There are many practical uses for this circuit. For instance, controlling the intensity of an air conditioner in a house or automated light for a concert or light show.

The other task I was involved in is the sodium dye-laser experiment. The experiment worked on in the laboratory is only a small part of a larger experiment. The whole experiment involves shooting a laser beam at the sodium resonance wavelength to the mesosphere where there is a layer of sodium. The beam interacts with sodium particles and causes them to fluoresce. Some of the scattered light comes back down to earth, and is used to measure the aberrations caused by the turbulence in the atmosphere. The purpose of the experiment in the laboratory is to amplify the earthbound fluorescent light to enable measurement of higher-order aberrations.

All in all the program which I was involved in was set up pretty well. This job was different from other jobs because there was no daily routine. Whatever needed to be done at a certain time got done at that time. It was interesting working with people older than myself because it matured me more and made me more self-dependent. The AFOSR program also helped me narrow down what I want to study in college and perhaps choose a career in. This program is a good learning experience and should be offered to more young people so that we have a direction in life and to help us make important decisions about college and careers.

Noise Reduction Improvement Testing: Comparing Old INTEL to New INTEL

Joseph C. Senus
High School Summer Apprentice

Abstract

The INTEL algorithm modification developments under a project set up by a contractor were evaluated for their effectiveness when used as a preprocessor for either human or machine recognition. The plan presented by this contractor describes a series of tests that he ran on a certain INTEL we called Old INTEL. He then devised an INTEL that supposedly worked better than the Old INTEL we called this the New INTEL. Our project was to run both INTELs and compare the results to see if the New INTEL was actually better.

MY AVIATION FUEL RENDEZVOUS

Jonathan D. Servaites
High School Apprentice
Centerville High School

Abstract

During my summer tour I participated in research with both sections of the Fuels Branch of the Air Propulsion and Power Directorate at Wright Laboratory (WL/POSF), Fuel Development and Fuel Combustion. A primary concern of Fuel Development is based around the rapidly growing heat loads generated by the engine and aircraft subsystems. Fuel Development works with this problem by analyzing aviation fuel's role as a cooling medium for aircraft subsystems. All U.S. aircraft match heat load with available heat sink of the fuel. However, with increasing temperatures, greater thermal stability and heat sink capability are needed to help curb fuel fouling in current systems and to provide further security in the future. Therefore, Fuel Development has established the "JP-8+100" program that offers a JP-8 fuel with 100°F (56°C) improvement in thermal stability. This task is to be accomplished by the means of an additive package. The additive package should cost less than $0.001 per gallon and would significantly reduce the amount of engine and subsystem maintenance that is currently needed.[1] During the latter part of my summer tour, I also spent time working in Fuel Combustion. The primary objective of this program is to provide the fundamental understanding of gas and liquid fueled combusting flows needed to develop gas turbine combustor design models that result in errors of less than 5% in predicted flow field parameters such as temperature, velocities, and species concentrations. In the program's hope of bettering methods for designing gas turbine combustors, a "vaporline" visualization technique was developed where water droplets, vapor from the droplets, and their interaction with the carrier gas are observed simultaneously.[2]

A STUDY OF THE IONOSPHERE

Min Shao
High School Student
Arlington High School

Abstract

The ionosphere is a partly ionized region of the upper atmosphere. It is important to the Air Force because anything that is (radio) signal passing through the ionosphere will be effected by it. The Air Force has both communications and radars that are effected by the ionosphere. At Phillips Laboratory, GPS (Global Positioning System) satellite signals are used to study the ionosphere. Phillips Laboratory has operated stations to receive the signals from the GPS satellites in Shetland ,United Kingdom, Shemya, Alaska, Hanscom Air Force Base, Massachusetts, and Thule, Greenland. The stations at Shemya are being run currently.

A STUDY OF THE EFFECTS OF LIQUID PROPELLANT 1846 ON THE FERTILITY, PREGNANCY AND LACTATION OF RATS

Ryan Quinn Simon
High School Apprentice
Air Force Toxicology Division
Wright Patterson Air Force Base

ABSTRACT

The effect of Liquid Propellant 1846 is being studied. The United States Army is considering replacing the solid propellant used in the Advanced Field Artillery System with a new liquid type of propellant. The propellant was administered to Sprague-Dawley rats through their drinking water. Later the rats were mated and observed. Behavioral tests were also being performed on the rats. Because the study is not yet completed no data concerning the fertility of male rats, or the pregnancy and lactation of female rats. It is known that the propellent is a skin and eye irritant, and in aerosol form is a respiratory irritant. Enlarged Spleens were noticed in the test animals.

A VERIFICATION OF THE NGM- AND LFM-MOS FORECASTING MODELS' CLOUD AMOUNTS FORECASTS

Adam Smith
Summer Research Intern
Phillips Laboratory
Atmospheric Predictions Branch
Hanscom Air Force Base

Abstract

This project was intended to test the relative accuracies of the LFM MOS and NGM MOS forecasting model's cloud coverage forecasts. These models are used to forecast several variables, including cloud coverage amounts, twice per day (0Z and 12Z). Data from thirty stations was gathered over a period of five weeks, three days per week. Each data set consisted of the NGM and LFM predictions for that station over 36 hours and the actual observed cloud cover amounts over the same period, as well as a "persistence" forecast which predicts that the conditions present at the beginning of the period will remain present throughout the entire period. This data was then analyzed by comparing each of the NGM, LFM, and persistence forecasts with the actual conditions observed later. The LFM and NGM models both performed well, and both better than the persistence-based forecast, as expected.

PERMEABILITY CONSTANTS DETERMINED BY PBPK MODELS FOR VAPOR, NEAT, AND AQUEOUS FORMS OF PERC, BENZENE, DBM, AND TCE

Jill A. Solscheid
Centerville High School

Abstract

A permeability constant is the measure of the ability of a chemical to penetrate through the skin. The constant can be mathematically computed by a Physiologically-based Pharmacokinetic (PBPK) Model. The stratum corneum, which was separated from rat skin using a trypsin method, was used to determine the stratum corneum to air partition coefficients, a parameter of PBPK models. PBPK models were developed which described each of three different in vivo dermal exposures in rats: whole body dermal exposure to vapor, exposure to neat chemical from a closed cell on the dorsal skin, and exposure to a saturated solution in water from a closed cell. The permeability constants were determined for the three forms of perchloroethylene, benzene, dibromomethane, and trichloroethylene with the exceptions of perchloroethylene saturated and trichloroethylene vapor which do not have sufficient data. Human data can easily be calculated because the PBPK model can extrapolate between species. Therefore, the permeability constants can be used to predict human skin exposure for dermal risk assessment.

DIAMOND GROWTH BY LOW-PRESSURE CHEMICAL VAPOR DEPOSITION WITH BIAS PRETREATMENT

David J. Spry
Summer Apprentice
Department of the Air Force
Wright Patterson Air Force Base

Abstract

This report discusses the preliminary results of several microwave plasma assisted chemical vapor deposition (MPCVD) biasing experiments. Substrate biasing was shown to substantially increase nucleation of diamond on silicon. Possible reasons for this effect are also proposed.

CHANCE OF A LIFETIME

Jennifer A. Starr
student
Trotwood Madison Sr. High

ABSTRACT

This report will explain the knowledge obtained, while working at Wright Patterson Air Force Base. It will cover computer operation, hypermedia ,and various computer applications In addition, this report will discuss my experience with Internet. Examples of the work done in the past eight weeks will be shown.

MODIFICATION OF M18 FOR EMAA EXTINGUISHING PURPOSES

Jefferey R. Strickland

High School Research Student

Abstract

A new class of fires suppressants, known as Encapsulated Micron Aerosol Agents (EMAA), having superior volumetric efficiency, low initial and life cycle costs, low toxicity, no known global atmospheric environmental impacts, and with the potential for a wide variety of applications, is being developed through a joint program between the private sector and the U. S. Air Force. Through the modification of the M18 smoke grenade an evaluation of a portable method for the delivery of EMAA can be accomplished. This innovative application is one of the many possible with this promising new agent.

Optical Scatter Measurements in an Ultrahigh Vacuum Chamber

Tony K. Tecumseh
Summer Student Intern
University of Puget Sound

Abstract

The optical scatter of light off a sample was studied. A dye laser pumped by a Nd:YAG laser was used as the light source. A dye laser was also used in order to pulse the beam. The actual scattering measurements occurred inside an ultrahigh vacuum (UHV) surface analysis chamber. A researcher, targeting a sample, was able to obtain a bidirectional reflectance distribution function (BRDF) measurement. Various samples were analyzed. Most of the samples had a coating of contaminant. A sandblasted stainless steel disc was used as a secondary reference standard. A second laser was used to align the sample. The system is capable of measuring optical scatter levels around 10^{-7} sr^{-1}.

The Effects of Wet and Dry Silicon Dioxide Passivation Etchants on Aluminum Metallizations for Integrated Circuits

Nathan B. Terry
Senior
Clinton Sr. High School

Abstract

The capability of six surface analysis techniques to determine the effects of passivation etchants on aluminum metallizations was examined. A buffered hydrofluoric acid wet etchant and a plasma tetrafluoromethane dry etchant commonly used to etch silicon dioxide passivation layers were studied. Atomic Force Microscopy was shown to have the highest topographical resolution while Auger Electron Spectroscopy and ESCA both gave significant elemental surface information.

Hypervelocity Impact Studies Utilizing Semi-Empirical Codes

Randy Thomson

High School Apprentice

Abstract

One of the tasks of the Technology Assessment Branch (MNSA) is to assess the lethality of hypervelocity kinetic energy weapons against foreign aerospace threats. MNSA uses several analytical tools to fulfill this task. Chief among these tools are Eulerian codes with fixed grids, excellent for modeling the massive distortions that occur in the initial hypervelocity impact; Lagrangian codes with flexible grids that accurately model late time structural response; and semi-empirical codes, which rely on engineering models based on actual theories that are empirically fit to experimental data using regression techniques. The Eulerian and Lagrangian codes provide accurate results, but require enormous amounts of computer time, even on modern supercomputers. A need was seen for a fast-running code that could provide accurate data on desired lethality criteria. These codes have existed for some time, but due to their nature, require extensive amounts of ongoing analysis to accurately portray hypervelocity impacts as more experimental data becomes available. During the summer of 1993, the accuracy of semi-empirical tools for modeling hypervelocity impact was studied, and the information drawn from this research is the basis for this report.

THE PROTECTION OF FIGHTER PILOTS AGAINST GRAVITY

Zayda M. Triana
Incarnate Word High School

Essay

The acceleration of high-speed planes causes fighter pilots to experience a lurching similar to that which occurs when one turns sharply in a car: one's body sways to the side due to the tendency of an object in motion to remain in motion and follow a straight path. The "pull" of gravity which a pilot senses is a stronger force than someone would feel while standing at rest on the ground, and therefore the human body responds to it differently. Instead of the normal circulatory path through which the blood flows under 1 G, the blood begins to pool at the feet, causing the brain to be deprived of oxygen. Without enough oxygen to the brain, the fighter pilot's peripheral vision begins to blacken out, and before the pilot can compensate for the loss of sight, he loses consciousness, or "G-locks."

Area Centroid Analysis

Christina M. Trossbach
High School Apprentice
Advanced Processing Systems Branch
WL/MNGA

Abstract

The project studied was to determine the effects of the Gain & Offset Compensation on the Area Centroid. Gain & Offset and Area Centroid are two of seventeen signal processing algorithms that were used in the testing and evaluation. The Area Centroid is the location of the center of the area of a target. A program in Pascal was created to calculate the output, and the Area Centroid was found in coordinate form.

EXPERIENCE IN THE METHODOLOGY SECTION AT WRIGHT-PATTERSON AIR FORCE BASE

Miranda H.T. Tseng
High School Apprentice
Methodology Section
Wright-Patterson Air Force Base

Abstract

In the Survivability Enhancement Branch of the Vehicle Subsystem Division, information was obtained about the survivability and vulnerability of composites through basic research and testing conducted in a gunnery range. Different types of data were collected from the tested composite panel and from associated reports. Accumulated results were put into a data base that contained raw data from previous tests. This data base was then updated and completed. The findings were in turn reduced and analyzed for further use. Plans for future tests to support methodology development were also made. These plans included the determination of data that will be needed to support the thesis of these developmental tests. Besides research settings, a general work atmosphere was observed and the ability to fit into the office environment was gained.

THE DEVELOPMENT AND ANALYSIS OF A SPARKGAP FIRESET

Darcie Tutin
High School Apprentice
Fuzes Branch
Wright Armament Laboratory Directorate

Abstract

The purpose of this project was to make a fireset which would be an accurate way to send high currents through test items. The development of a sparkgap fireset was ideal because of its low inductance and resistance. It was possible to analyze waveforms received on an oscilloscope from the current viewing resistor to find total circuit resistance and inductance. These values were then compared to P-spice simulations.

REAL TIME 12 BIT ANALOG TO DIGITAL COMPUTER INTERFACE

Christopher M. Vaill

Abstract

Two prototype printed circuit boards were designed and constructed for use in the computer interface to a microwave life test system at Rome Laboratory. Computer aided design (CAD) tools were used for both schematic circuit design and printed circuit design. The prototype circuit boards were created with a computer controlled milling machine. Upon testing, both the A/D converter and the power conditioner board had minor errors which were corrected for the final circuits. In addition, minor output errors in both CAD programs were overcome with a bit of troubleshooting and three post processing programs written in the C language.

BALLISTIC HOLOGRAPHY

Jon R. Ward
High School Apprentice
Instrumentation Technology Branch
Wright Laboratory Armament Directorate

ABSTRACT

My summer was spent working as an apprentice in the Instrumentation Technology Branch (WL/MNSI) on Eglin Air Force Base. My mentor was Mr. David Watts and my project focused on ballistic holography in the laboratory run by Advanced Ballistic Holography program manager, Mr. Joseph Gordon. This technology can be used in place of orthoganol flash X-ray to make replicated three-dimensional images of any objects in ballistic testing. A computer program may be developed to turn the image into digital data and analyze the fragmentation. It can be used in three-dimensional modeling, behind panel fragmentation analysis, and lethality/survivability analysis.

COMPARISON OF ATOMIC ABSORPTION AND ICP ATOMIC EMISSION SPECTROMETERS

Kathy Jeterman
High School Apprentice
Arnold Engineering Development Center
Arnold Air Force Base

Abstract

Spectroscopy is the study of the interaction of electromagnetic radiation with matter. Spectroscopic instrumentation separates electromagnetic radiation into its component wavelengths which enables one t measure the intensity or strength of the radiation at each wavelength. This intensity can then be calculated into concentration. The chemistry lab at Arnold Engineering Development Center {AEDC} uses both atomic absorption spectrophotometry with atomic emission spectroscopy for analysis. The personnel at AEDC were unsure of the correlation between results from the instruments due to a previous comparison which found they did not yield corresponding results for some elements. However, the instruments had not been rigorously calibrated or standardized during this testing period. This project was designed to reveal if the instruments could produce accurate and precise results for a known sample when properly calibrated and standardized

The ICP and AA did yield comparable results on metals in water when properly calibrated and standardized. Further investigation could reveal which instrument has the better sensitivity and repeatability for each element, and this information could be used to determine which instrument has the best performance for each element.

THE ANAYLSIS OF INORGANIC SUBSTANCES FOUND IN WATER, SOIL AND AIR

Suzanne G. Weidner
student:
East Central High School
San Antonio, Texas

Abstract

This summer as a repeat participant in the HSAP summer research program for high school students, many new and different areas of an analytical laboratory were exposed. The everyday function of the lab and the many tests performed daily were presented and explained once again in an efficient manner. As an apprentice, real laboratory experience was gained which had not been learned the previous year. Hands on participation was encouraged with equipment found in the lab. While running all of the tests, safety was stressed so caution was taken. At all times a lab jacket, rubber gloves and goggles were worn. This year, accuracy was stressed once again so exactness and preciseness was taken while measuring or calculating sample results. Once the results were found, they were distributed back to the field where they originally came from. The origins of the samples came from all over the United States and world.

Comparison of the Figures of Merit for the Baseline Non-exhaustive Search Methods Versus the Number of Partitions

A Study in Pattern Theory

Johnny R. West, Jr.
Student
Belmont High School
Dayton, Oh.

ABSTRACT

The recent advancements in machine learning theory, computational complexity, and logic minimization has lead to a new study in the world of computer science referred to as Pattern Theory. This is the study of how computers recognize patterns and, more importantly, the study of "pattern-ness." Through years of extensive research and experimentation, a robust Occam based pattern recognition and learning has been developed. However, this program is not as fast as it needs to be, nor is it as convenient as it needs to be for application to "real world" problems. Currently, these problems are being researched.

DATABASE PROCESSING AND SECONDARY ELECTRONS

Matthew J. Wick

Abstract

This summer I worked in both an office and a laboratory at Phillips Laboratory. This division of time offered extensive variation in my daily activities. To enhance this variation, I was assigned several short tasks to complete rather than one or two lengthy ones. These tasks ranged from managing personnel data in a spreadsheet database to designing and building a dial counter to measure the degree rotation of an electron gun located inside a vacuum chamber.

Scott Williams's report not available at time of publication.

My Summer Working with Phillips Laboratory

By Rudy Wright

This summer working with Phillips Laboratory has been an experience. I had the privilege of working in two buildings. These buildings were the Space Experiment Building (SX) and the Meteorology Building (WE). Working in these buildings brought new challenges ahead for me and my co-worker Andrea Garcia. This eight week program has been a learning experience. I have learned many new things this summer like working with computer packages, weather files, and many people.

My first week here I had the opportunity to see the lift off of a project that had been in the making for quite some time. This project was called HABE. HABE stands for High Altitude Balloon Experiment. It was to be launched at 0600 on June 15 in Clovis, New Mexico. Once we arrived at the launch site we took a first look at HABE. The launch actually took place at 0715. The takeoff was a success but after that everything went on the down side. Attached (figure 16-1) is a picture of the structure of HABE and it shows where it went bad. What went wrong was a mystery for a while. It turned out that some wires had been miswired. This shows how something as little as a wire can foul up an entire experiment. Once we returned from our destination it was time to start working on the data received from this mishap. We worked on this for quite sometime. While doing this we learned how to work with programs such as Microsoft Excel, Mathcad, and Drawperfect(See figures 16-2/16-9). Figures 16-2 through 16-6 show altitude versus pressure, temperature, time, relative humidity, and wind

EXAMINATION OF THE NITRATE REDUCTASE GENE THROUGH NUCLEOTIDE SEQUENCING, GENOMIC LIBRARY PREPARATIONS, AND SOUTHERN BLOT TECHNIQUES

Matthew Young

High School Apprenticeship Program

Abstract

The course of research focused on the nitrate reductase gene found in barley and certain bacteria. The work mentioned herein is supplementary, contributing to a more extensive, long term research project. Although many different protocols involved in contemporary molecular bioengineering were examined, there were three primary techniques used most extensively: (1) The use of the dideoxy-mediated chain termination method to sequence the barley nitrogen reductase gene transformed into the virus, M13, (2) the isolation of DNA from P. stuzeri and B. anthrax for the creation of a genomic library wherein the nitrogen reductase gene might be located, (3) execution of the Southern hybridization technique to scan bacteria for the likely presence of a nitrogen reductase gene hybridizing with the barley gene.

Active Noise Reduction

Amy Zimmerman

Abstract

Active noise reduction (ANR) is the wave of silence to the future. While passive techniques act as a barrier to noise, ANR equipment mirror images noise waves and sends the waves back at the noise obstruction, cancelling out part or all of the noise. ANR techniques also prove to work better at lower frequencies where passive control fails. For this experiment, a speaker was placed at the end of a 17'9.5" PVC pipe and a second speaker was placed 10 feet from the first. The first speaker was turned on and the second was phase and volume adjusted to cancel out the highest level of noise (only sine waves were used). This was repeated at three different locations on the pipe to check for global cancellation. The results showed that there was cancellation over a five foot area. Over all the trials, there was about a 30 dB reduction average. It can be concluded that a large amount of noise can be eliminated from this technique. This type of equipment can prove to be very beneficial for workers in noisy environments.